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DISSERTATION ON

"A COMPREHENSIVE STUDY ON COMPLICATIONS OF ENDOSCOPIC SINUS SURGERY"

Submitted in partial fulfillment of the requirements for

M.S. DEGREE BRANCH-IV OTORHINOLARYNGOLOGY

Of

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

UPGRADED INSTITUTE OF OTORHINOLARYNGOLOGY

MADRAS MEDICAL COLLEGE

CHENNAI – 600 003.

MARCH – 2010

CERTIFICATE

This is to certify that this dissertation entitled **"A COMPREHENSIVE STUDY ON COMPLICATIONS OF ENDOSCOPIC SINUS SURGERY"** submitted by **Dr. JUDE ANSELM SHYRAS. D,** appearing for M.S. ENT, Branch IV Degree examination in March 2010 is a bonafide record of work done by him under my supervision in partial fulfillment of regulations of the Tamil Nadu Dr. M.G.R. Medical University, Chennai. I forward this to the Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamilnadu, India.

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CONTENTS

INTRODUCTION

The nasal endoscope has revolutionized the diagnosis and treatment of disease of the nose and paranasal sinuses. Functional Endoscopic Sinus Surgery is now the standard of care for surgical treatment of chronic and recurrent sinusitis. It is the most exciting recent development in the field of Otorhinolaryngology. We are now able to discover hitherto unknown areas, detect diseases at the earliest stages, and look around the corners in the nose and actually peep into the sinuses. While operating we have the advantage of good illumination and clear vision with minimally invasive surgery. The endoscope even enhances post operative management in helping rapid healing and early detection of any recurrent diseases.

Stammberger[1], Messerklinger[2], Wigand[3], and Kennedy and colleagues[4,5] created a revolution in the thinking and surgical management of nasal sinus disease. The ability to use nasal endoscopy for the diagnosis, identification of sinus and nasal pathology within the narrow spaces and recesses of the nose, and delicate management of the disease has benefited the patient by more accurate surgery, preservation of function, and faster healing. From its introduction, the concepts of endoscopic sinus surgery continue to evolve because of increased understanding of the anatomy, improved endoscopes and video equipment, newer instrumentation, and improved technology.

Endoscopic surgery aims at maintaining the physiological function and anatomic structure. The extent of the operation is adapted according to each case. It is focused on the osteomeatal complex in the middle meatus and the ethmoidal cells. The term Functional Endoscopic Sinus Surgery is used to draw attention to the potential for reestablishing sinus drainage and mucosal recovery.

Because of highly variable individual anatomy and the intimate relationships to the orbit, anterior cranial fossa and vascular structures, sinus surgery has many potential complications. Excellent visualization by recent advances in endoscopic technology and detailed preoperative and intra operative analysis of complex anatomy by improved radiographic technology of Computed Tomography scan, Magnetic Resonance Imaging scan and image guidance navigation systems help in reducing the potential complications.

Most of the reported complications are minor. Experience of the surgeon and familiarity with the endoscopic anatomy and its variations play an extremely important part in reducing complications. With Functional Endoscopic Sinus Surgery, it is possible to achieve consistently good results, provided the surgery is done accurately and with care.

AIMS OF STUDY

1. To evaluate the various complications of endoscopic sinus surgery
2. Factors influencing the occurrence of these complications
3. Measures to be taken to prevent the occurrence of complications
4. Management of the complications

REVIEW OF LITERATURE

ANATOMY OF LATERAL NASAL WALL & PARANASAL SINUSES

Surgical anatomy:

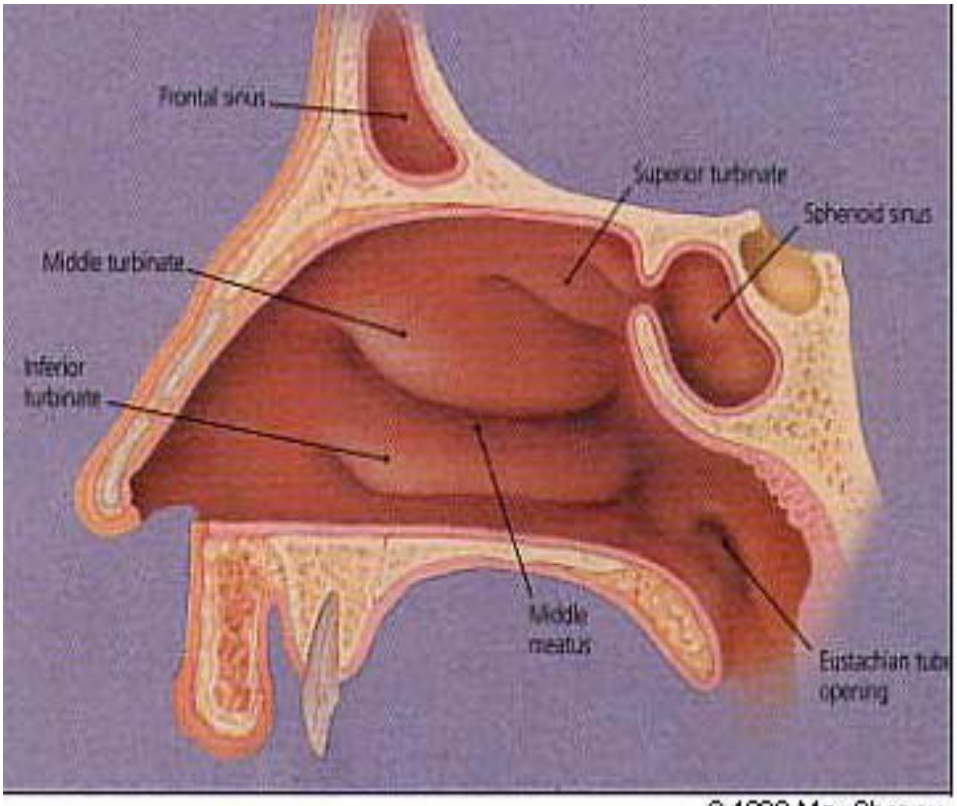
The introduction of functional endoscopic sinus surgery (FESS) by Messerklinger[2] and Wigand[3] radically changed the way otolaryngologists treat sinusitis. For safe surgery, a clear understanding of sinus surgical anatomy is fundamental.

Ethmoid sinus:

Of all the paranasal sinuses, the ethmoid sinus is the most complex and is aptly referred to as a labyrinth. The anterior cells of this sinus first appear in the third fetal month as pits of the lateral nasal wall adjacent to the middle meatus[6]. At birth, the anterior ethmoid measures 2 x 2 x 5 mm, and the posterior ethmoid measures 2 x 4 x 5 mm; they are difficult to view with routine radiography. The ethmoids attain adult size by the twelfth year, expanding into adjacent areas beyond its capsule[7]. In the adult, the ethmoids are pyramidal in shape, with the base located posteriorly. They measure 4 cm to 5 cm anterior to posterior, 2.5 cm in height, 0.5 cm wide anteriorly, and 1.5 cm wide posteriorly[8].

The roof of the sinus, the fovea ethmoidalis, usually extends 2 to 3 mm above the more medial cribriform plate. The entire ethmoid bone is a paired scaffolding held together by two lamina cribrosa. Each lamina cribrosa is separated in the midline by an upward projection, the crista galli. The

LATERAL WALL OF NOSE



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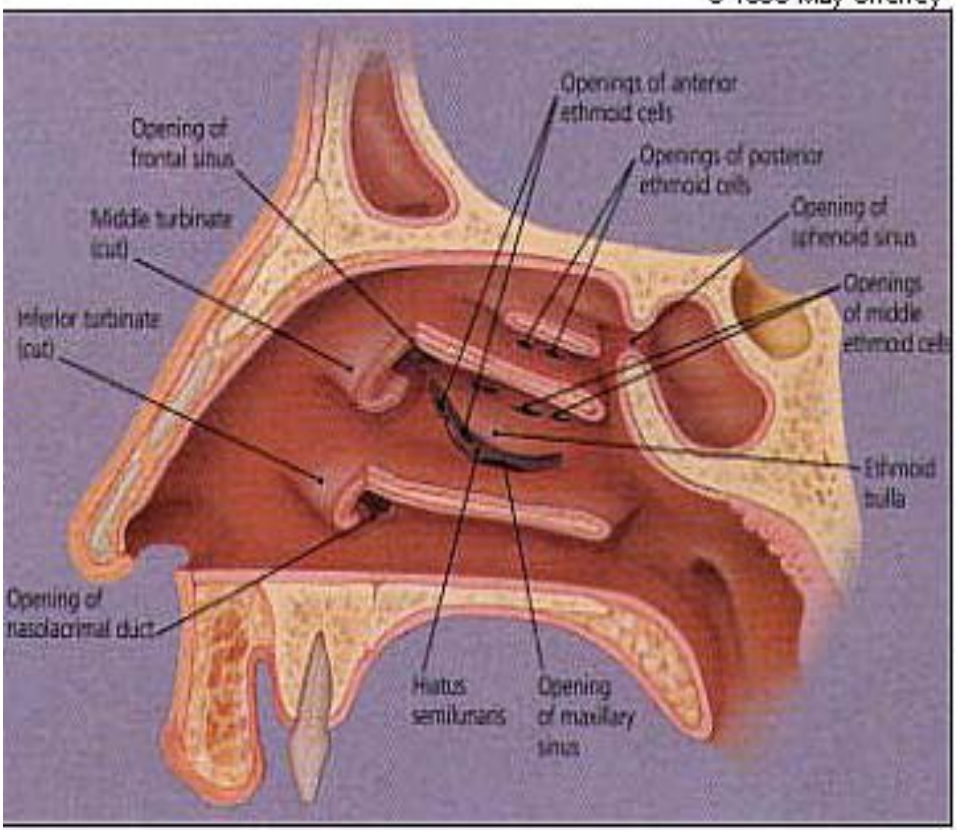
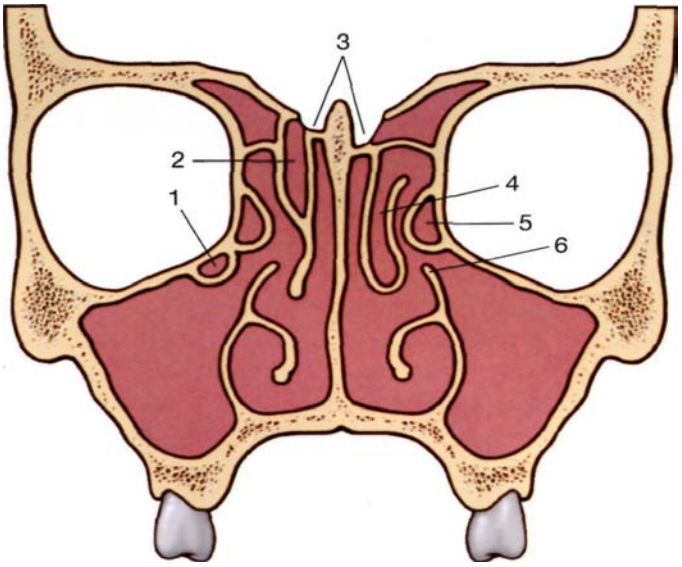


perpendicular plate of ethmoid lies inferior and opposite the crista galli. The ethmoid labyrinth forms the greater portion of the ethmoid bone. Laterally, the lamina papyracea forms the bony division from the orbit. Any dehiscence of this lamina forms a potential pathway for spread of sinus infections into the orbit. Medially, it is bounded by the middle, superior, and (if present) supreme turbinates. Posteriorly and inferiorly, the ethmoid clefts open into the corresponding nasal passages and finally into the choanae. The anterior roof is bounded by the downward extension of the frontal bone.

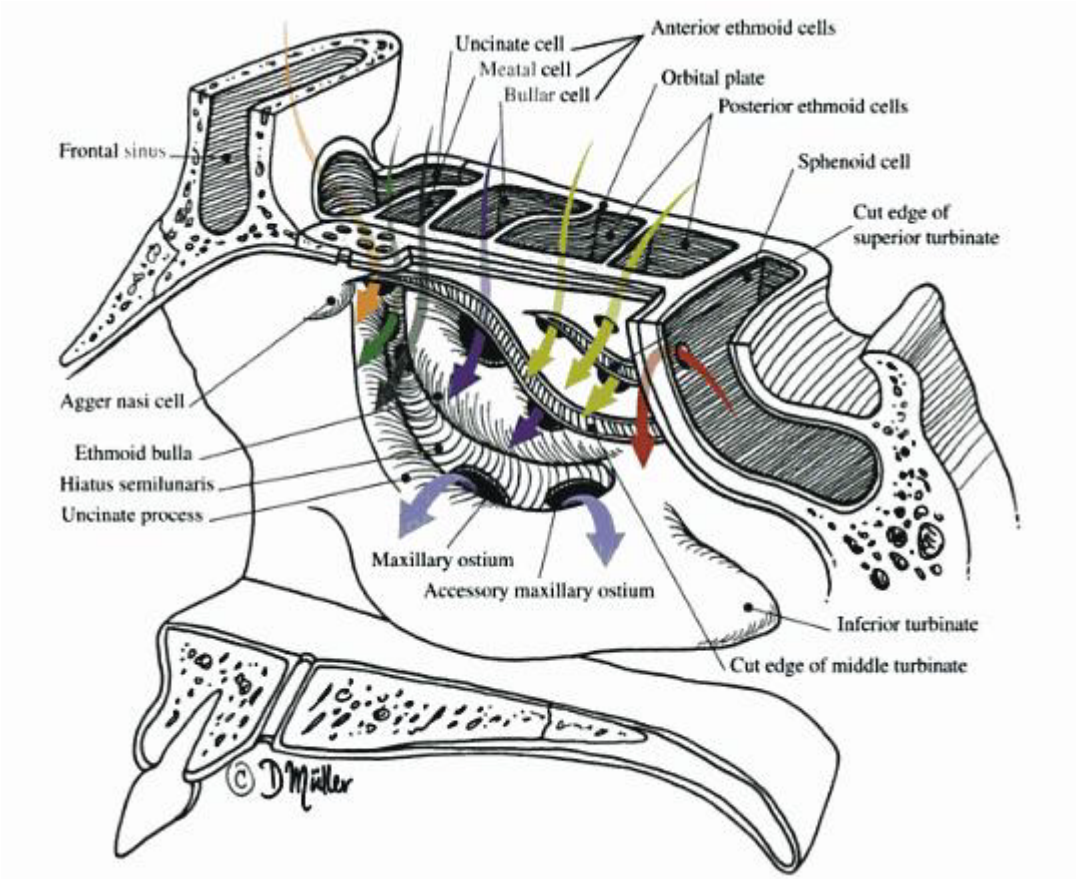
The complex ethmoid labyrinth is divided into a series of lamellae, which are relatively constant and can help guide the surgeon during the surgery. These lamellae are the uncinate process, the bulla ethmoidalis, the ground lamella of the middle turbinate, and the lamella of the superior turbinate. Rarely, there is a fifth lamella known as the supreme turbinate. The ground lamella of the middle turbinate is a constant and well-developed lamella. It divides the ethmoid into anterior and posterior portions. The anterior cells are smaller and more numerous than the posterior cells. Most sinus disease involves the anterior ethmoids. Several important anatomic landmarks are associated with this structure.

The ethmoid box may be divided into three zones[9]. Zone A, the anterior Osteo Meatal Complex is from the anterosuperior attachment of the middle turbinate to the posterolateral attachment of the middle turbinate. Zone B, the posterior Osteo Meatal Complex is from the posterolateral attachment of the middle turbinate to the face of the sphenoid bone. Zone C, the sphenoid zone is

PARANASAL SINUSES



DRAINAGE SYSTEM OF PARANASAL SINUSES



from the face of the sphenoid sinus to include the sphenoid sinus and its neighboring structures.

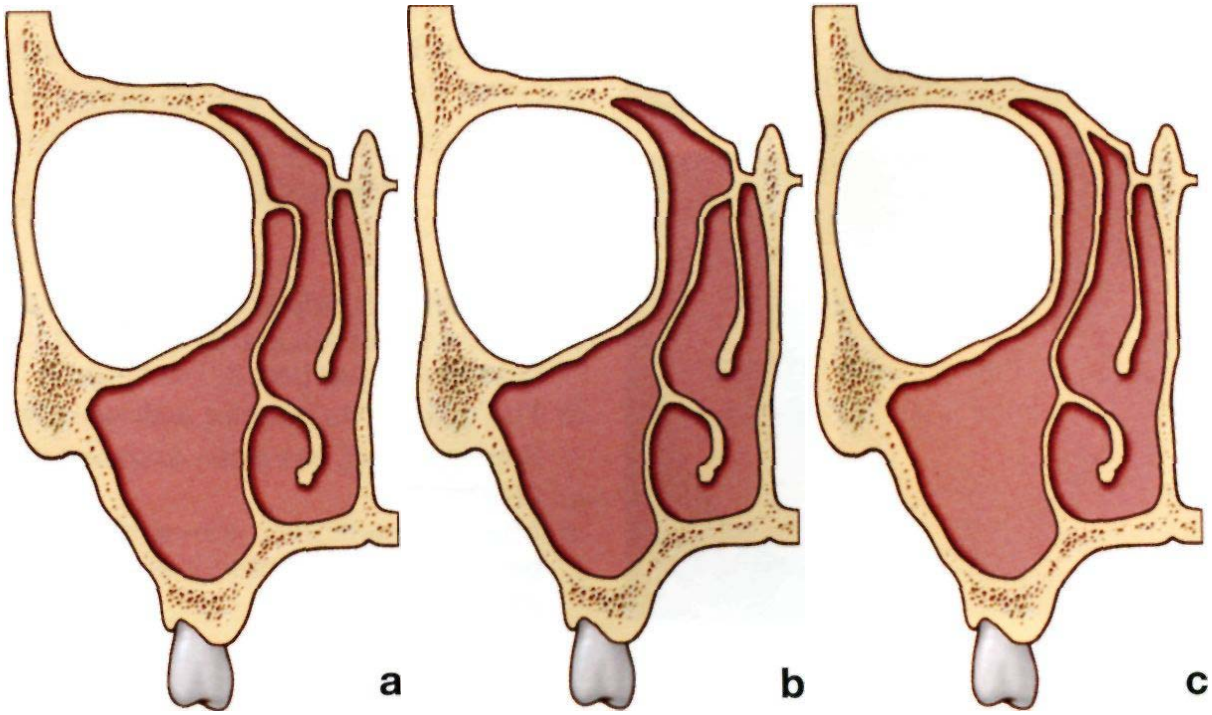
Uncinate process:

The uncinate process is a thin and almost sagitally oriented bone. It runs in a sickle-shaped curve from anterosuperior to posteroinferior. Its anatomy is better appreciated by medializing the middle turbinate. It is approximately 3 to 4 mm wide and 1.5 to 2 cm in length. Its posterior margin is sharp and concave. It is anterior and parallel to the anterior surface of the ethmoid bulla. The hiatus semilunaris occupies the space between the posterior aspect of the uncinate and the anterior surface of the ethmoid bulla. The lateral surface of the uncinate forms the medial surface of the infundibulum. Posteriorly and inferiorly, the uncinate attaches to the ethmoidal process of the inferior turbinate bone. The posterior-superior attachment is to the lamina perpendicularis of the palatine bone[10]. The ascending anterior convex margin contacts the lateral nasal wall, which may extend up to the lacrimal bone.

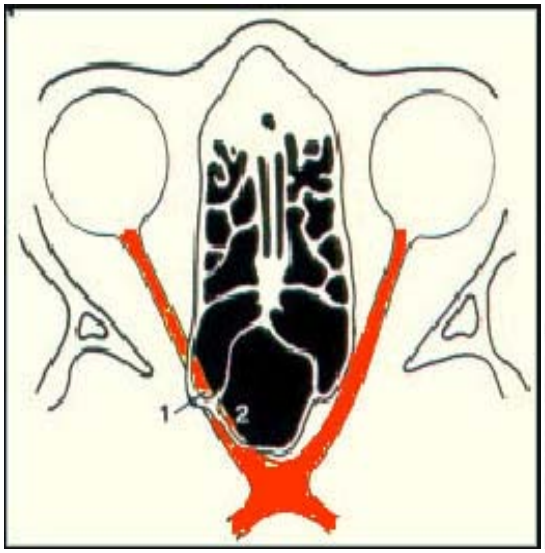
The uppermost segment of the uncinate process runs a variable course. It is hidden by the insertion of the middle turbinate. It can extend to the base of the skull or turn laterally to insert into the lamina papyracea and may turn frontally and fuse with the insertion of the middle turbinate[10].

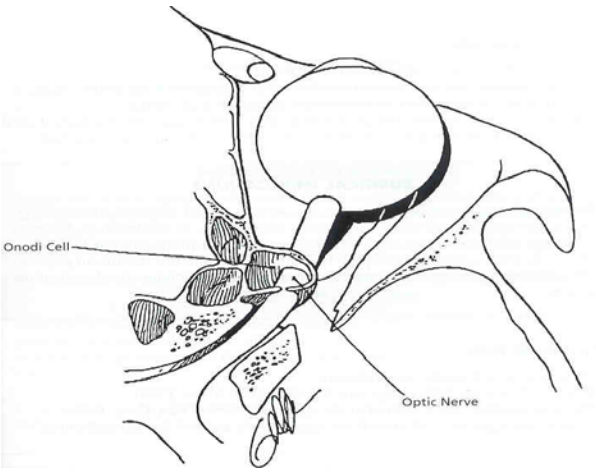
There are almost always defects between the uncinate and the inferior turbinate. These defects are covered with dense connective tissue and nasal

ATTACHMENT OF UNCINATE PROCESS



ONODI CELL





mucosa and are known as the anterior and posterior fontanelles. Accessory maxillary ostia are often observed in the posterior fontanelle region[11]. The uncinate is usually oriented at 140° to the lateral nasal wall and the lamina papyracea, but the orientation can vary significantly. Extensive nasal polyps within the infundibulum can displace the uncinate medially. It can be displaced laterally, as seen in maxillary sinus hypoplasia[12]. Rarely, the uncinate can be pneumatized[13]. Orbital injury can occur if lateral displacement of the uncinate (with accompanying atelectasis of the infundibulum) is not appreciated during the infundibulotomy[14].

Ethmoid bulla:

The ethmoid bulla is one of the largest and most consistent anterior ethmoid air cells. It is created by the pneumatization of the bulla lamella. Occasionally, the ethmoid bulla is poorly developed or absent[15]. It is located in the middle meatus, directly behind the uncinate process, and in front of the ground lamella of the middle turbinate. Superiorly, the anterior wall of the ethmoid bulla can extend to the skull base to form the posterior limit of the frontal recess. If this division is absent, there is direct communication between the frontal recess and the sinus lateralis, normally located above the bulla[14]. Posteriorly, the bulla can fuse with the ground lamella.

Variations include a highly pneumatized bulla lying in the lower aspect of the middle meatus. In this position, the ethmoid bulla can narrow the

infundibulum. If the ethmoid bulla is not pneumatized, a bony projection known as the torus lateralis forms from the lamina papyracea[9].

Hiatus semilunaris:

The hiatus semilunaris is a sagittal cleft between the posterior border of the uncinate process and the anterior surface of the ethmoid bulla. The middle meatus communicates with the infundibulum through this area, designated as the hiatus semilunaris inferior [16]. The hiatus semilunaris superior is the cleft formed between the posterior wall of the ethmoid bulla and the ground lamellae of the middle turbinate.

Ethmoid infundibulum:

The ethmoid infundibulum is a funnel-shaped, three-dimensional space located in the anterior ethmoidal region. It is bounded medially by the uncinate and laterally by the lamina papyracea. The frontal process of the maxilla and lacrimal bone forms its anterior-superior boundary[17]. The lumen of the infundibulum appears as a V-shaped structure in axial Computed Tomography. The posterior border of the infundibulum is bounded by a portion of the anterior ethmoid bulla and tapers in this direction. The ethmoid infundibulum can measure 4 cm in length and 5 mm to 12 mm in depth. The ethmoidal infundibulum communicates with the middle meatus through the hiatus semilunaris. Superiorly the infundibulum is closely related to the frontal recess, which depends greatly on the attachment of the uncinate process. The uncinate usually bends laterally to attach to the lamina papyracea; in this case, the

infundibulum and frontal recess are separated so the frontal recess opens into the middle meatus medial to the ethmoidal infundibulum between the uncinate process and the middle turbinate. Less commonly, the uncinate can attach to the ethmoid roof or insert into the middle turbinate; in this case, the frontal recess opens directly into the infundibulum.

Sinus lateralis:

The sinus lateralis is not a constant space but is typically found behind and above the ethmoid bulla. It is also called the suprabullar and retrobullar recesses. Its borders are the ethmoid roof superiorly, the lamina papyracea laterally, the ethmoid bulla roof and posterior wall inferiorly and anteriorly, and the ground lamella of the middle turbinate posteriorly. The ethmoid bulla often opens into the sinus lateralis. If the ethmoid bulla does not extend superiorly to form the posterior wall of the frontal recess, the lateral sinus may continue anteriorly into the frontal recess. The sinus can be reached through the superior hiatus semilunaris, between the ethmoid bulla and middle turbinate.

Ostiomeatal unit:

Naumann[18] described this functional unit. The term ostiomeatal unit refers collectively to the uncinate process, infundibulum, and anterior ethmoid cells. This area also contains the ostia of the anterior ethmoid, maxillary, and frontal sinuses.

Frontal recess and sinus:

Frontal sinus development begins in the fourth fetal month. Development is usually completed before 20 years of age[8]. The frontal sinus originates from the anterosuperior pneumatization of the frontal recess into the frontal bone. The adult sinus measures 28 mm in height, 24 mm in width, and 20 mm in depth[19]. It drains into the ostiomeatal unit through the nasofrontal duct. The frontal sinus is shaped like a funnel with its narrow end toward the duct ostium. The frontal recess lies inferior to the nasofrontal duct ostium. This recess is bounded by the middle turbinate medially, the lamina papyracea laterally, the agger nasi anteriorly, and the ethmoid bulla posteriorly. The frontal ostium is usually found in the most anterosuperior part of the frontal recess.

The ground lamella of the ethmoidal bulla is an important structure in relation to the frontal recess. It separates the frontal recess from the lateral sinus if the bulla lamella ascends to the roof of the ethmoid. Frequently the bulla lamella is incomplete, in which case the frontal recess may communicate posteriorly with the lateral sinus. Depending on the position of the uncinate process, the frontal recess may open into the middle meatus medial to the uncinate process or directly into the ethmoidal infundibulum[15].

There is significant variation in regard to the nasofrontal duct. This variation is better understood when one takes the agger nasi cell, frontal cells, and supraorbital ethmoid cells into account. Secretions from frontal sinus enter the middle meatus by passing posterior and medial to the agger nasi cell. If agger

nasi cells are extensively pneumatized, the frontal recess can be narrowed; this narrowing can predispose a patient to frontal sinusitis with minimal mucosal derangement. Cells may develop in the frontal bone near the frontal sinus, known as the bulla frontalis[10]. These cells open into the frontal recess. Supraorbital ethmoid cells are another anatomic variation caused by pneumatization of the frontal bone by ethmoid air cells. Stammberger[10] believes these supraorbital cells develop as an extension of the posterior frontal recess.

Agger nasi:

The term agger nasi means nasal eminence. This area is found just anterior to the middle turbinate's insertion into the lateral nasal wall. When the agger nasi is pneumatized by an anterior ethmoid cell, it forms an agger nasi cell. It arises from the superior aspect of the infundibulum or the frontal recess. It is bounded anteriorly by the frontal process of the maxilla, anterolaterally by the nasal bones, superiorly by the frontal recess, inferomedially by the uncinate process, and inferolaterally by the lacrimal bone. The superior aspect of the cell serves mainly as the anterior border of the frontal recess and to a lesser degree as the anteromedial floor of the frontal sinus.

Fovea ethmoidalis:

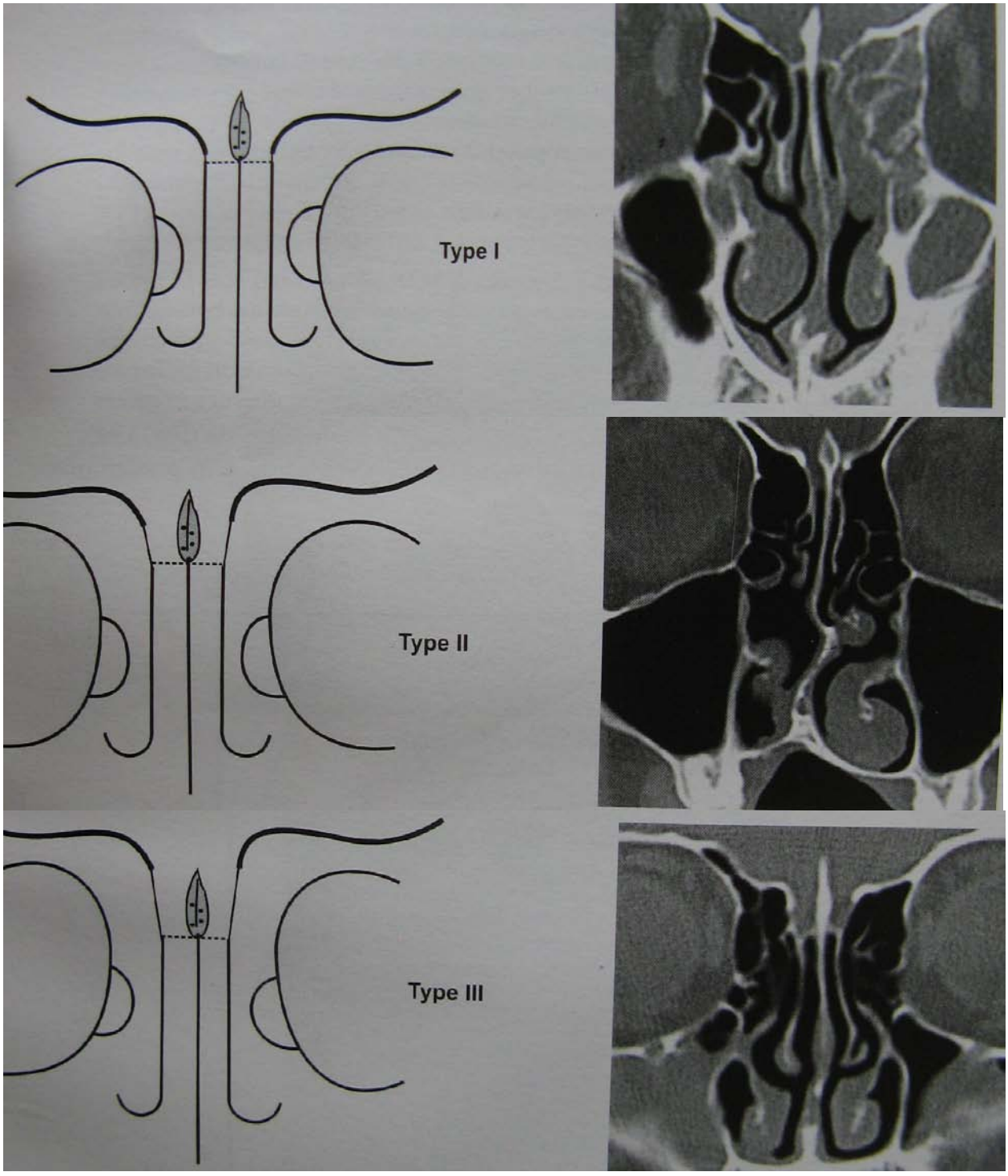
The frontal bone extends from the orbital plate to form the fovea ethmoidalis, or ethmoid roof. Here the frontal bone is thicker than the adjacent bone. The medial aspect of the ethmoid roof is formed by the lateral lamellae of

the cribriform plate, also known as the lamina lateralis of the lamina cribrosa. The roof may vary in height, width, shape, and by side.

Great caution must be exercised when operating along the skull base, especially medially near the thin lateral lamellae of cribriform plate. This area has a mean thickness of 0.5 mm. The lateral lamella may be only 0.2 mm in thickness. In these areas, perforation can easily occur. The relationship of the anterior ethmoid artery in this region is especially important as it leaves the orbit and enters the anterior cranial fossa. The ethmoidal sulcus, a groove in the lateral lamella containing the anterior ethmoidal artery, may be only 0.05 mm in thickness. The point of entry into the anterior cranial fossa at the lamina cribrosa offers least resistance to a probing instrument. Following the anterior surface of the ethmoidal bulla during sinus surgery leads the surgeon to the ethmoid roof and to the anterior ethmoid artery. If the bulla lamella extends to the roof of the ethmoid, the anterior ethmoid artery is usually found adjacent to this point. If the bulla lamella does not extend to the roof, the artery can be seen in the lateral sinus[15].

Keros [20] has described three types of skull base conformations. These categories relate to the risk of injury to the anterior skull base during sinus surgery. In type 1, the olfactory sulcus is 1 to 3 mm deep, and the corresponding lateral lamella is short. This is the least hazardous configuration. In type 2, the olfactory sulcus is 3 to 7 mm deep. In type 3, the sulcus is 7 to 16 mm deep; the lateral lamella contributes significantly to the ethmoid roof and makes this the

KEROS CLASSIFICATION



most hazardous configuration. By staying lateral to the insertion of the middle turbinate, the surgeon can avoid perforating the lamina cribrosa.

Posterior ethmoid:

The posterior ethmoid sinus is a collection of one to five cells that drain into the superior and supreme meati. It is bounded anteriorly by the ground lamella of the middle turbinate, posteriorly by the anterior wall of the sphenoid sinus, laterally by the lamina papyracea, medially by the superior and supreme turbinates, and superiorly by the ethmoid roof. The meati are located along the medial surface.

The behavior of the most posterior cells of the posterior ethmoidal sinus is of great importance to the surgeon. Onodi found that when the most posterior cell is highly pneumatized, it can extend posteriorly along the lamina papyracea into the anterior wall of the sphenoid sinus[21]. In this case, the optic nerve may be adjacent to the posterior ethmoid cell. To avoid injury, dissection should be medial and inferior. The internal carotid artery may also impinge the lateral wall of the posterior ethmoidal cells. Yellow orbital fat may be seen through the lamina papyracea in some cases.

Maxillary sinus:

At birth, the maxillary sinus has a volume of 6 mL to 8 mL. In the adult, it is triangular in shape. It measures 25 mm along the anterior limb of its base, 34 mm deep, and 33 mm high[22]. The floor of the sinus will be usually 4 mm to 5 mm below the floor of the nose in the adult. The sinus is bounded superiorly by

the orbital roof. The hard palate, alveolus, and dental portion of the maxilla comprise the inferior boundary. The zygomatic process forms the lateral boundary. A thin plate of bone separates the sinus from the infratemporal and pterygopalatine fossae posteriorly. The uncinate process and inferior turbinate form the medial boundary.

The natural ostium is located in the superior aspect of the medial wall of the sinus and drains into the hiatus semilunaris; it is an elliptical structure measuring between 1 mm and 20 mm in diameter[22]. The ostium is seen behind the lower attachment of the uncinate process and above the superior portion of the anterior superior aspect of the inferior turbinate.

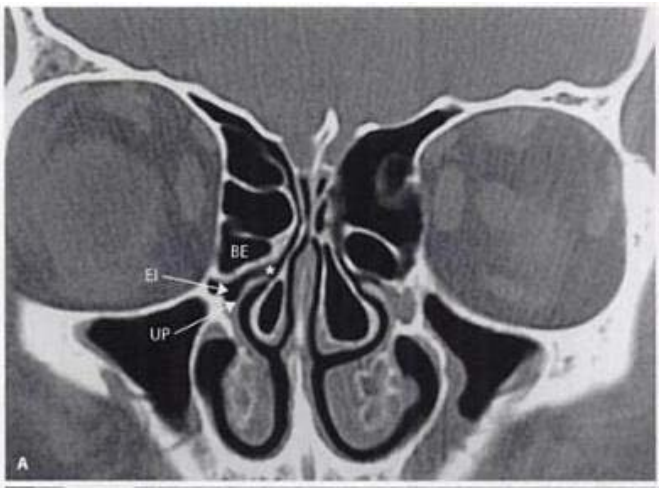
Intraorbital ethmoid cells, also known as Haller cells, are the most common anatomic variation. They arise from the anterior ethmoid in 88% of individuals or from the posterior ethmoid in 12% [23]. These cells develop into the floor of the orbit above the natural ostium of the maxillary sinus. They are easily seen on coronal Computed Tomography. When a Haller cell becomes diseased, the natural ostium of the maxillary sinus may become obstructed. Other variations may occur. Another variation is hypoplasia or atelectasis of the maxillary sinus. Uncinectomy is difficult in these cases because of the risk of orbital injury from lateral displacement of the uncinate. Accessory maxillary sinus ostia are another common variation. They can occur in 20% to 50% of patients[8]. These are located in the infundibulum or the membranous meatus inferior to the uncinate but above the insertion of the inferior turbinate.

Sphenoid sinus:

There is minimal development of the sphenoid sinus until 3 years of age. After this period, the sphenoid sinus begins to pneumatize the sphenoid bone. Sometimes these sinuses are highly pneumatized to form prominent lateral recesses. The sphenoid sinus develops into adulthood to measure 20 mm high, 23 mm deep, and 17 mm wide on average[8]. The right and left sphenoid sinuses are separated by the intersinus septum. Occasionally this septum may be asymmetric. It frequently deviates laterally and superiorly, inserting into the bony prominence over the optic nerve or internal carotid artery. Thus, sphenoid septum manipulation must be done with caution to avoid visual or hemorrhagic complications. The ostia of the sphenoid sinus are usually located in the sphenoethmoidal recess, medial to the superior turbinate. The ostia may be slitlike, oval, or round in shape[15]. The average distance from anterior nasal spine to the sphenoid ostium is 7 cm[24].

The vidian nerve passes along the floor of the sphenoid. On the lateral wall, two bulges may be produced by the optic nerve and carotid artery; these bulges may be covered only by thin bone and in some cases are dehiscent. The anterior wall of the sphenoid is not always located immediately posterior to the most inferior posterior ethmoid; the inferior aspect of an Onodi cell may be 1.5 cm superior to the anterior wall of the sphenoid sinus.

CHONCHA BULLOSA



PARADOXICAL MIDDLE TURBINATE

AGGER NASI

Anatomic variations

Uncinate process

Medially bent uncinate:

A medially bent uncinate is the most common variation[15] and may involve the entire uncinate. Sometimes the uncinate can protrude anterior-inferior to the middle turbinate, giving the impression of two middle turbinates. Superiorly, the uncinate may bend laterally and insert onto the lamina papyracea. It attaches to the skull base in this fashion. It can also twist medially and fuse with the middle turbinate.

Laterally bent uncinate:

Lateral protrusion of the uncinate can also narrow the ethmoid infundibulum.

Elongated and enlarged uncinate process:

An elongated and enlarged uncinate process may come in close contact with the ethmoid bulla, significantly narrowing the hiatus semilunaris.When concomitant mucosal derangements are present, this narrowing may lead to obstruction.

Pnuematization of uncinate:

Rarely, the uncinate may be pneumatized causing narrowing of the infundibulum.

Ethmoid bulla

Enlarged ethmoid bulla:

Bulla pneumatization can vary. A greatly pneumatized bulla may extend anteriorly to contact the uncinate process, resulting in a narrow hiatus semilunaris. The bulla may extend anteriorly to protrude between the uncinate and the middle turbinate.

Middle turbinate

Concha bullosa:

Pneumatization of the middle turbinate is known as a concha bullosa. Its pneumatization varies and is usually bilateral. A concha bullosa is not a pathologic finding. In the setting of chronic sinus disease, resection of the concha bullosa should be considered to improve paranasal sinus access. A concha bullosa pneumatized from the frontal recess can communicate with this area. This communication can result in disease affecting both the frontal sinus and the connected concha bullosa. The concha bullosa interior may be affected by the disease in other sinuses, which ranges from mild edema to mucocele.

Paradoxically bent middle turbinate:

The middle turbinate may curve laterally with its concave surface adjacent to the septum. This distortion usually occurs bilaterally. This distortion alone is not pathologic but can contribute to severe narrowing of the middle meatus if other mucosal derangements are present.

HISTORY OF NASAL ENDOSCOPES

The history of nasal endoscopy and of endoscopic sinus surgery parallels advances made in the development of instruments suitable for examining the small confines of the nose, nasopharynx and the paranasal sinuses. Bozzini is credited for the development and use of the first "light conductor". Subsequently, Czermak, who coined the term "rhinoscopy," popularized the use of the nasal speculum, an instrument that was unknown to him, had already been in use during the first century in Pompeii.

The second stage in the development of endoscopy began with the development of the cystoscope by Nitze-Leiter in 1879, with a platinum wire light source, which was modified and used to examine the orifice of Eustachian tube. Endoscopy was first performed by Hirschmann[25] in 1903 using a modified Nitze cystoscope which he used in the nasal cavity and in the maxillary sinus via a tooth socket. In 1922, Speilberg[26] was the first to introduce an endoscope into the maxillary sinus via the inferior meatus, but it was in 1925 that Maltz commissioned Wolf to make a dedicated endoscope and who introduced the term sinoscopy. In the 1950s, Hopkins, Professor of Optics at Reading, invented a far superior system, based on solid glass rods, which is now universally in use.

These advances, along with the development of computed tomography, made it possible for clinicians to localize sinus disease and thereby redirect their therapeutic interventions.

Messerklinger is credited as the first to develop a systematic approach to diagnosing and treating sinus inflammatory disease. He noted that despite the seemingly extensive nature of the disease process in remote areas of the nose and paranasal sinuses, in most cases these observations could be explained by relating anatomical form to function. The frontal, maxillary and anterior ethmoid sinuses converge on a rather limited area known as the ethmoid infundibulum, which comprises one component of the osteomeatal unit. Other structures in this area include the uncinate process, the middle turbinate and the ethmoid bulla. Physiologically, this area is important in the etiology of inflammatory sinus disease.

Obstruction either by inflammation, polyp, tumor, or by dysfunction of the normal mucociliary clearance mechanisms in this area leads to primary disease that can progress and cause contiguous infection of the larger paranasal sinuses, or secondary disease.

Functional endoscopic sinus surgery is based on the premise that removing the obstruction to normal mucociliary clearance in the area of the Osteo Meatal Complex will lead to subsequent clearance of secondary disease

and restoration of normal mucociliary clearance. This is in contrast to more extensive interventions in which nearly all accessible mucosa is debrided. Although this is sometimes necessary, as in severe nasal polyposis, such extensive procedures usually are not required and add to the overall risk of complications.

Early in this century, Mosher[27] stated that intranasal ethmoidectomy is "the blindest and most dangerous operation in all of surgery." While this may have been true then, the endoscopic approach to intranasal surgery has afforded surgeons unparalleled illumination and clarity of the surgical field. Despite these advances, with their attendant reductions in morbidity and mortality, complications remain a real concern when performing endoscopic sinus surgeries. They are divided into major complications including: death, intracranial hematoma, massive hemorrhage, blindness, orbital hematoma, and Cerebro Spinal Fluid leak, and minor complications including synechiae, orbital emphysema, acute asthma exacerbation, epiphora, hyposmia, anosmia and dysgeusia.

Even when performed by the most experienced surgeons, using a traditional or an endoscopic approach, sinus surgery may be associated with complications.

Complications:

Complications are usually classified broadly as major or minor, but how these categories are defined varies. According to Levine & May[28], it has been classified as whether they resolved spontaneously, were corrected with treatment, or were permanent. Major complications were those that usually required treatment to prevent permanent serious sequelae or that caused permanent serious sequelae despite treatment. And other complications were considered minor.

The major complications were further classified as resulting from violation of orbital, intracranial, vascular or lacrimal structures. All intracranial violations are major complications, even if repaired at the time of occurrence and there were no post operative seqelae. Permanent lacrimal duct obstruction is also considered a major one, whether or not it requires treatment.

Category	*Treatment category*	*Complication*
Major	Correctable with treatment	Orbital haematoma (post septal) Loss of vision Diplopia Cerebrospinal fluid leak Meningitis Brain abscess Focal brain damage Haemorrhage requiring transfusion Carotid artery injury Epiphora
	Permanent	Blindness Diplopia Central Nervous System deficits Death
Minor	Temporary, requires no treatment	Periorbital emphysema Periorbital ecchymosis Dental or lip pain or numbness
	Temporary, correctable with treatment	Adhesions requiring treatment Epistaxis requiring packing Bronchospasm Sinus infection
	Permanent if persists beyond 1 year	Dental or lip pain or numbness or anosmia

Prevention and management of complications

Orbital penetration:

Orbital penetration may lead to one of three major or two minor complications, depending on which zone of the orbit is penetrated.

Zone A:

No complications may result if the lamina propria is violated, but the periorbita is not. If the periorbita is also violated, periorbital ecchymosis or subcutaneous emphysema may result.

One way to prevent orbital penetration in Zone A during endoscopic sinus surgery is to take care when removing the uncinate process, especially when the uncinate process is lateralized or the lamina propria is dehiscent. Frequently the uncinate process is lateralized when the septum is deviated, with or without a concha bullosa or a lateralized paradoxical turbinate.

To prevent violation of the orbit Stankiewics[29] recommends keeping two fingers on the globe to palpate for the vibrations transmitted from the nasal cavity. The fingers may also be used to apply gentle pressure on the globe while watching intra nasally for movement of the lamina or bulging of intraorbital fat through the lamina. Fat should be distinguishable by its yellow, globular, greasy appearance.

To prevent subcutaneous emphysema, when the lamina papyracea has been violated in the Zone A, positive pressure insufflations by mask is discouraged during emergence from general anaesthesia and the patient should be told not to blow the nose for a week after the surgery.

Preseptal ecchymosis resulting from penetration of the orbit in Zone A usually resolves spontaneously over 5 – 10 days.

Zone B & C

Penetration of the orbit in Zone B may result in retrobulbar haematoma, a major complication with threat of vision loss or diplopia resulting from damage to the medial rectus muscle.

To avoid violating Zone B, an axial Computed Tomography scan should be examined preoperatively and at the time of surgery, so that the surgeon can appreciate the shape of the ethmoid complex. A wedge shaped versus oblong ethmoid complex puts the orbit at greater risk because the ethmoid cells lie closer to the optic nerve and orbital cone. On occasion, a lateralized posterior ethmoid cell may actually envelop the optic nerve (onodi cell).

Signs of retrobulbar haemmorhage are dramatic and usually occur during surgery.

1. The eyelid become ecchymotic
2. The globe becomes proptotic
3. Intraorbital tone increases
4. Extraocular muscle movements become limited
5. The pupil of the affected side dilates and becomes less responsive to light
6. Vision may diminish with progression of pressure
7. Retrobulbar hemorrhage may occur when biting forceps used in Zone B to grasp polyps or infected tissue is inadvertently used to grasp and remove orbital material. Alternatively this complication may result from tearing the anterior ethmoid artery.

Usually retrobulbar hemorrhage is self limiting and will respond to conservative measures like,

1. Removal of nasal packing
2. Administering diuretic medications like mannitol or acetazolamide
3. Steroids
4. Ophthalmologist consultation

If the hematoma progresses, especially if intraorbital pressure increases and visual acquity decreases, the orbit should be decompressed and hemorrhage should be controlled without delay. Once vision is impaired, pressure must be relieved within 60 to 90 minutes[30] to prevent permanent deficit. If retrobulbar hemorrhage is due to lacerated anterior ethmoid artery that has retracted into the orbit, an external procedure is usually necessary to manage the tear. Lateral canthotomy and inferior cantholysis should be performed to reduce temporarily intraorbital pressure until the bleeding can be managed definitively. The surgeon more experienced in endoscopic sinus surgery may decompress the orbit intranasally using the endoscope[31]. An external ethmoidectomy may be necessary, if endonasal structures cannot be visualized because of disease or the effects of the surgery.

Optic nerve damage may occur as a result of violation of the lamina papyracea during ethmoid or sphenoid sinus surgery in Zones B & C. The nerve may be prominent in the lateral wall of the posterior ethmoid sinus (onodi cell)

or the sphenoid sinus, and in 4% of cases, the nerve is dehiscent, separated from the sinus cavity only by its sheath and sinus mucosa[32]. Blindness that occurs intraoperatively or postoperatively is evaluated as for retrobulbar hemorrhage.

Optic nerve decompression may be indicated, particularly in cases of delayed blindness because decompression has been shown effective to treat traumatic optic nerve injury[33]. Although delayed blindness would imply that the optic nerve has not been transected, before considering optic nerve decompression to relieve blindness magnetic resonance imaging should be performed to evaluate the possibility of surgical disruption of the nerve.

Diplopia:

Diplopia may occur with retrobulbar hemorrhage or with minor ocular complications (preseptal hemorrhage or emphysema). When caused by pressure alone, this sign usually resolves as the primary condition improves. If the medial rectus or superior oblique muscle is damaged directly[34], however, the prognosis is very poor for recovery of function, even with surgical intervention. Fortunately, this complication is quite rare.

Dural complications of Endoscopic Sinus Surgery

Leakage of cerebrospinal fluid:

Pathognomic of Cerebrospinal fluid leak is the “wash out sign”. Clear fluid leaking through a defect in the dura washes away the blood from the ethmoid roof. As with the penetration of the orbit, when a dural tear occurs the

anaesthesiologist should be informed and should avoid assisted ventilation by bag and mask when the patient is emerging from general anaesthesia, because of the danger of inducing pneumocephalus. Patient is instructed not to blow the nose for three weeks postoperatively for the same reason.

Many endonasal techniques have been reported effective in closing the dural tears[35]. It can be managed by removing disease from the area of the dural tear and rotating the middle turbinate over the defect. If the middle turbinate is not available, then fascia, fat, or muscle is taken from the patient's scalp or abdomen. The tissue graft is held in place with a nasal dressing for 48 hours, during which time antibiotic medications are administered.

After repair of the Cerebrospinal fluid leak, if minimal Cerebrospinal fluid drainage is noted, and continues beyond three to five days, an intrathecal drain may be placed. Although such a drain may be beneficial, it increases the risk of intracranial infection and pneumcephalus. It may be prudent, especially if drainage is more than minimal, to return the patient to the operating room, and explore the site of the dural tear. Most cases of Cerebrospinal fluid leakage occur when mucosa is removed from the roof of the ethmoid, without associated instrument penetration of the dura. If an instrument did penetra ı, however, a Computed Tomography scan should be obtained to evaluate for intracranial damage.

Brain injury:

Penetration of the brain is a potentially fatal complication of paranasal sinus surgery[36] that must be treated aggressively. The defect in the dura should be closed as described for the management of Cerebrospinal fluid leakage, and an evaluation for central nervous system deficits should be carried out. Neurosurgical consultation should be obtained immediately, if a sudden change in vital signs, especially bradycardia and hypotension, occurs while the patient is under general anaesthasia. Such a change may indicate intracranial hemorrhage. A Computed Tomography scan should be obtained and reviewed in consultation with the neurosurgeon to determine the extent of brain damage. Elective neuro surgery may be decided on if there is evidence of continued bleeding.

Bleeding:

Bleeding associated with surgery may occur intraoperatively, immediately postoperatively (that is within 24 hours), or later in the post operative period (delayed bleeding).

The typical blood loss during endoscopic sinus surgery, whether performed with local or general anaesthesia, is about 75cc, much less than with a traditional external approach. Some patients lose significantly more blood than the average. In most cases, this occurs because of the factors related to their disease. Patient's whose sinus mucosa is hyperplastic, leathery, and friable as a result of previous surgery tend to bleed more than others. Once mucosa is

removed in any patient, however, significant bleeding from the mucosa usually stops.

Bleeding from the nasal sinus mucosa is minimized by the topical application of a decongentant, the injection of a vasoconstrictor medication, and anaesthesia techniques that keep the patient hypotensive. General techniques to manage bleeding during Endoscopic Sinus Surgery, include haemostasis and cautery.

Hemostasis:

Oozing of blood during Endoscopic Sinus Surgery can be controlled effectively by periodic applications of an oxymetazoline or epinephrine (1:1000) moistened cotton pledget. The pledget is removed after few seconds, if oozing persists, the pledget is placed in the sinus cavity and surgery is continued elsewhere for few minutes.

Anterior Ethmoidal Artery:

The anterior ethmoidal artery is usually well protected by a bony canal, as it crosses the anterior aspect of the roof of the ethmoid sinus at the level of the anterior face of the bulla ethmoidalis, just behind the nasofrontal recess. When bleeding from this artery does occur, usually it is easily controlled by applying an oxymetazoline or epinephrine (1:1000) moistened cotton pledget. If the injured portion of this artery retracts into the orbit however, intraorbital bleeding can occur. To control this bleeding, the vessel may need to be exposed via an external ethmoid sinus approach and cauterized with a wet-field bayonet bipolar

forceps. Suction cautery is usually effective in controlling the bleeding from the territory of the anterior ethmoidal artery along the ethmoid cavity roof.

Spheno palatine artery:

Pulsatile bleeding that begins when the surgeon is operating at the inferior aspect of the face of the sphenoid is usually from the sphenopalatine artery, which runs from the lateral to medial just above the arch of the posterior choana. Injury to this artery usually occurs when the posterior attachment of the middle turbinate is avulsed or when the inferior aspect of the face of the sphenoid is entered. Injury to this artery can be avoided by sharply cutting the middle turbinate rather than avulsing it, not disturbing the posterior attachment of the middle turbinate, and displacing the mucosa from the face of the sphenoid inferiorly towards the arch of the posterior choana before penetrating the face of the sphenoid.

Bleeding from the sphenopalatine artery can be controlled by bipolar or suction cautery. If suction cautery is used, it should be applied in short bursts interspersed with saline irrigation to prevent heat buildup and possible injury to the adjacent orbit, dura, and optic nerve.

Carotid artery injury:

The carotid artery is rarely injured during sinus surgery, but any procedure that involves Zone C carries the risk of this serious complication. The sphenoid sinus septum may be abnormally thin and attaches to a thin walled carotid canal, where the risk is very high.

Violation of the carotid artery is immediately evidenced by profuse hemorrhage that must be controlled, the instant it is recognized. To control the hemorrhage, the patient's nose and the oropharynx must be packed with whatever materials are available. Blood volume is replaced by crystalloid solutions until blood is available for transfusion.

The patient is assessed for the neurological deficits, which may involve allowing the patient from general anaesthesia to awaken. Management of carotid artery injuries will vary depending on the experience of the available surgeons for the consultation from balloon occlusion to flowseal. Sofferman[37] suggested the carotid drill that to be followed.

Carotid drill

In a Tertiary care center:

1. For every sinus case, have two long Merocel sponges available on momentary notice for nasal packing.
2. Pack nose immediately at the first sign of severe hemorrhage.
3. Compress the carotid artery in the neck on the affected side.
4. Begin anesthesia to induce controlled hypotension.
5. Ready blood for transfusion.
6. Call neurosurgery immediately.
7. If the patient is unstable, the neuroradiologist should perform an intraoperative arteriogram. If the patient is stable, transfer to the neuroradiology suite.

8. Perform a balloon occlusion under Electroencephalogram surveillance.

A. If there are no changes indicating a change in perfusion or lateralization, ligate the carotid artery.

B. If changes occur on Electroencephalogram (dangerous recording), deflate the balloon, maintain packing, and observe.

9. Insert Swan-Ganz catheter. Put the patient in a hyperdynamic state by using high molecular weight starch to increase cerebral perfusion.

10. After cerebral perfusion has been increased, reinflate the balloon and check the Electroencephalogram.

A. If lateralization occurs; try a carotid bypass or barbiturate coma.

B. If bypass is possible, reinflate the balloon and ligate the carotid artery.

In a Nontertiary hospital:

1. Call neurosurgery.

2. Expose the carotid artery in the neck.

3. Temporarily occlude the carotid with a clamp or tape.

4. Ligate the carotid artery.

5. Perform a trapping procedure: clip the carotid artery below anterior communicating artery to isolate this segment from blood flow.

The risk of violating the carotid artery is decreased by:

1. Studying preoperative axial Computed Tomography scans of the sphenoid sinus to identify the structure in the superolateral wall of the sphenoid sinus, noting its spatial relationship to the optic nerve
2. Recognizing that carotid canal dehiscence have been identified in 8 to 25% of specimens[32]
3. Remembering that an intersphenoid sinus septum may be attached to a thin carotid artery canal and manipulation of such a septum is, in fact, the cause of the carotid artery hemorrhage.
4. Avoiding reaching into the sphenoid sinus with forceps; rather, material should be drawn out of this sinus with suction.

Post operative bleeding:

Bleeding during the first 24 hours after the surgery usually arises from raw edges of mucosa left after removal of the middle turbinate, or after surgery in a patient with massive polyposis or history of previous surgery. When post operative bleeding occurs, it usually managed with the medicated anterior nasal packing. It is unusual for a patient to have further bleeding after this dressing is removed 24 hours later.

If blood oozes out after the dressing is removed, spraying the operative area with oxymetazoline often stops the oozing. If frank bleeding restarts,

however, the nose may need to be repacked. Should this procedure fail to stop bleeding, the patient is taken to the operating room for endoscopic localization and cautery of the source of bleeding. Most often, such postoperative bleeding arises from the territory of the sphenopalatine artery, either along the face of sphenoid sinus or from the posterior aspect of the residual middle turbinate.

Delayed bleeding may be due to premature separation of crusts within the nasal or sinus cavity. The problem can be minimized by keeping the cavity moist through provision of humidified air and topical application of saline spray to the nose and allowing crusts to separate on its own. Post operatively these crusts formed of blood clots, serve as a biologic dressing and are only disturbed if the patient experiences nasal stuffiness, pressure or pain. In these cases, gentle suction is used to dislodge loose crusts.

Lacrimal complications:

Epiphora, caused by lacrimal duct damage, is an annoying complication of endoscopic sinus surgery that often can only by corrected by a secondary surgical procedure. The lacrimal duct is most often damaged when remnants of the uncinate process are removed or the maxillary sinus ostium is enlarged using side biting forceps. This is because the uncinate process diverges as a wing of the lacrimal bone.

In fact, this close relationship between the uncinate process and the lacrimal bone probably results in lacrimal duct damage occurring more often than surgeons believe. A clue to such damage is a patient’s comment that when

he or she blows the nose, air comes into the eye. Symptomatic lacrimal duct injury can be evaluated and managed quite well endoscopically.

The best way to prevent damage to the lacrimal duct is to be careful when removing bone with the side biting forceps. When the forceps is used to enlarge the maxillary sinus ostium, the blade of the forceps should be kept within the infundibulum and not placed in the maxillary sinus.

Adhesions & Stenosis:

Adhesions are most likely to develop in the patients with massive disease, a very tight osteomeatal complex, or a history of previous sinus surgery. Attempts to preserve the middle turbinate during the endoscopic sinus surgery also seem to be more often followed by this complication, because adhesions can be anticipated anywhere mucosa is denuded or abraded and in close proximity to another structure. These circumstances most often arise between the inferior turbinate and the septum, middle turbinate and the septum and the middle turbinate and the lateral nasal wall. Adhesions in the last area are more troublesome if they obstruct drainage from the frontal, anterior ethmoid, and the maxillary sinuses into the osteomeatal complex.

The incidence of adhesions may be lowered by taking care not to abrade or denude mucosa along the lateral surface of the middle turbinate. When factors predisposing to adhesions are present, a stent may be placed to discourage the complication. Stent should be left in place for approximately a week

postoperatively. Another technique to discourage adhesion of the middle turbinate to the lateral nasal wall is to remove the anterior third of the turbinate.

Stenosis of the maxillary sinus ostium may be discouraged by manipulating the ostium as little as necessary. A normal ostium should not be disturbed, and when the ostium must be opened, only a portion should be enlarged, preferably the segment toward the posterior fontanelle. To enlarge the ostium, a mucosal flap is created by cutting with a sinus scissors from the natural ostium to the posterior extent of the fontanelle in a procedure referred to as a maxillary sinus ostioplasty. The flap created is rotated medially and inferiorly over the inferior turbinate.

When ostium stenosis does occur, it should be treated under direct visualization and monitoring through a canine fossa sinoscopy. The ostium should be opened widely at the expense of the posterior fontanelle and the superior turbinate. Furthermore, a silastic stent can be left in place upto 3 weeks to keep the ostium patent.

Asthma:

Patients should be screened carefully preoperatively to identify those with reactive airway disease or asthma, because in these patients bronchospasm needs to be anticipated and may need to be managed aggressively perioperatively. Patients with more severe disease will benefit from hospital admission 24hours before surgery for administration of steroids, inhalation bronchodilators and chest physiotherapy. Consultation with a pulmonary specialist is required.

Patients with steroid dependent asthma should be given a bolus of 100mg hydrocortisone sodium succinate intravenously at the start of surgery and by continuous infusion until the patient can resume oral intake.

Other complications

Dental or Lip pain or numbness:

Changes in the sensation in the teeth or lips may result from damage to branches of the infraorbital nerve, which most often occurs with canine fossa puncture. The risk of such injury during this procedure is decreased by keeping lateral on the anterior face of the maxillary sinus, avoiding sliding toward the infraorbital canal or medially and inferiorly to the roots of the canine and incisor teeth.

The bony wall between the nasal cavity and the maxillary sinus contains branches of the sphenopalatine nerve. If these branches are injured, for example during extensive middle meatal antrostomy or creation of a nasoantral window, neuralgia or dysesthesia may result. Disruption of the nasal branch of the sphenopalatine nerve, such as may occur during septoplasty, may result in incisor dysesthesias.

Infections:

Patients who have chronic suppurative sinusitis need intensive antibiotic therapy, perhaps including admission to the hospital for intravenous administration of medications before endoscopic sinus surgery is performed. If the infection is present in the maxillary sinus, a middle meatal maxillary sinus

antrostomy is performed and the new opening connected to the natural ostium. Sphenoid sinusitis is treated by removing the entire anterior wall of the sinus to reach and remove the disease. Disease obstructing the nasofrontal region is removed to treat frontal sinusitis. All infected sinus are irrigated and inspected to be sure they are clear of abnormal secretions or fungus deposits.

Anosmia:

Disturbance of the olfactory cleft, either by polyps or removal of the special mucous membrane between the middle turbinate and roof of the nose, may lead to disturbance of smell. Patients who experience such disturbance may notice a return of olfaction with a bolus course of steroid medications, which is a good sign in that it indicates that loss of olfaction is probably due to mucosal obstruction rather than damage to the olfactory mucosa.

To prevent disturbances of smell, the olfactory cleft should not be disturbed on the nasal side. Avoidance of this area will also decrease the risk of dural penetration.

Miscellaneous complications

Toxic shock syndrome:

Toxic shock syndrome is characterized by body temperature of 38.2° C or greater, exanthema with erythroderma followed by desquamation and orthostatic hypotension or shock. This is caused by toxins produced by Staphylococcus

aureus in association with dressings or packing materials left in a closed cavity, and although this syndrome is rare, it has been reported with endoscopic sinus surgery[38].

Lubricating dressings or packing with antimicrobial agents doesnot protect against toxic shock syndrome. Therefore, the best way to decrease the risk of this possible complication is not to leave any dressing in the nose. If an intranasal dressing is necessary, the time the material remains in the nose should be kept to a minimum.

Latex allergy:

The incidence of sensitivity to latex is reported to be as high as 7% among surgical personnel and 40% among spina bifida patients, and anaphylaxis and death have occurred as a result of sensitive persons being exposed to this material

Myospherulosis:

Placement of petroleum containing medications in a surgically created cavity has been reported, although rarely, to cause myospherulosis[39]. The mechanism apparently involves a soft tissue reaction to phagocytosis of petroleum molecules followed by formation of chronic granuloma. To avoid this complication, intranasal dressings with a bactericidal topical medication (mupirocin) that contains propylene glycol is used instead of petrolatum.

Dilated pupil during surgery:

Marked dilatation of one or both pupils has been noted during endoscopic sinus surgeries. This condition is disconcerting because it suggests serious injury to the optic nerve, but no evidence of such injury has been found and the condition clears spontaneously within an hour after surgery. Dilatation may be due to the injected epinephrine or lignocaine or topically applied phenylephrine.

Developing surgical skills to avoid complications:

Experience with the endoscopes can be gained by examining the preoperative patients in the office set up, and then using the instruments to remove the crusts, old blood and mucus from sinus cavities of patients who have been operated. By using the endoscope to visualize suctioning and manipulating forceps to treat postoperative conditions, the surgeon will acquire the basic skills necessary for intra operative techniques.

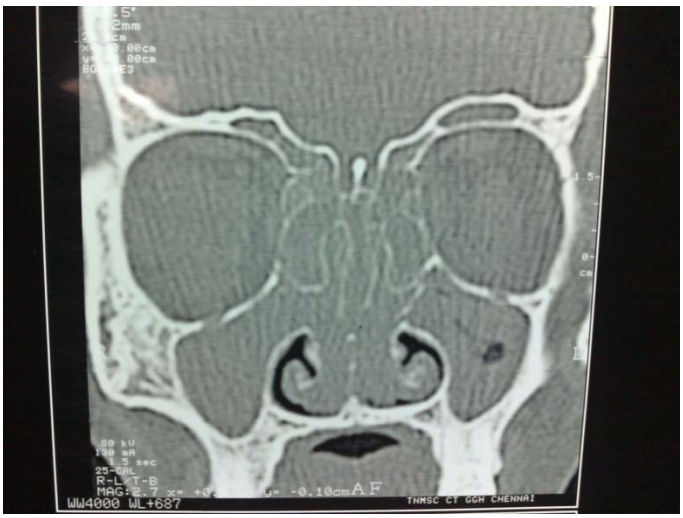
MATERIAL & METHODS

The study was a prospective study. Institutional ethical committee clearance was got for the study. During the study period from July 2008 to September 2009, the patients attending the outpatient department of the Upgraded Institute of Otorhinolaryngology, Madras Medical College & Government General Hospital, Chennai were screened for chronic sinusitis and sinonasal polyposis. Resistant cases, even after intensive medical management for six weeks, were advised for surgery. These patients were explained about the study. Those who have given the consent were included in the study as per inclusion and exclusion criteria.

Detailed history of complaints and their duration were obtained. Prior medical and surgical history was obtained. All the patients were subjected to a detailed ENT clinical examination. Diagnostic nasal endoscopy was done for all the patients. If there were findings suggestive of sinusitis, osteomeatal complex disease, the patients were subjected to radiological examinations like X-ray Paranasal Sinuses and Computed Tomography Scan Paranasal Sinuses.

COMPUTED TOMOGRAPHY – CHRONIC SINUSITIS

COMPUTED TOMOGRAPHY – SINONASAL POLYPOSIS



Inclusion Criteria:

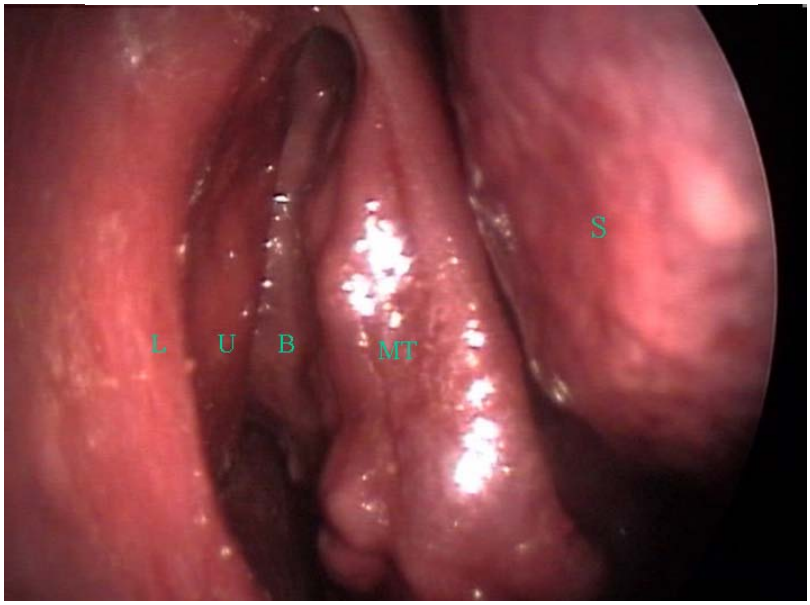
1. Patients with chronic sinusitis / sinonasal polyposis, not responding to intensive medical management (at least 6months) and with supportive Diagnostic Nasal Endoscopy and radiological findings were selected for endoscopic sinus surgery
2. Age group above 14years and below 60 years
3. Only those who have given consent, to be included in the study, after a detailed explanation about the study.

Exclusion criteria:

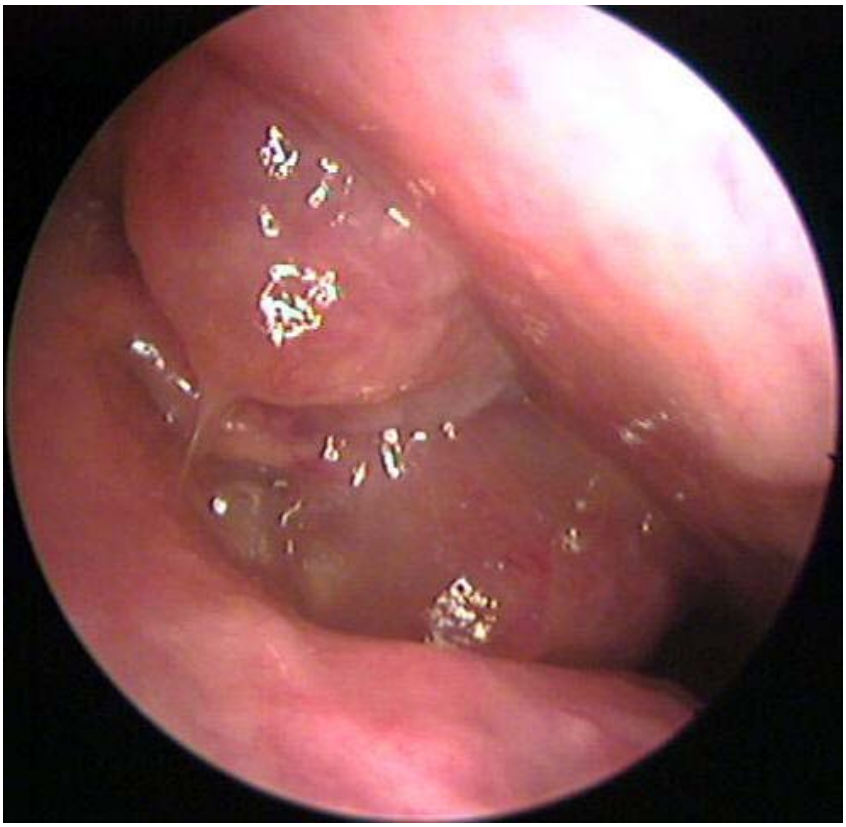
1. Age below 14 years & above 60 years
2. Those who are not willing for the study
3. Pathologies like lesions of the pituitary, orbit, lacrimal apparatus, intracranial complications of sinusitis and neoplasm were excluded from the study
4. Gross septal deviation, in which endoscopic sinus surgery could not be performed without septal correction.
5. Patients with bleeding diathesis and other general conditions like Diabetes and Hypertension, which may complicate the intra operative and postoperative period.

Patient selection involves a thorough history and physical examination, a trial with medical management and finally Computed Tomography imaging. The

DIAGNOSTIC NASAL ENDOSCOPY



SINONASAL POLYPOSIS



result is highly selected group of patients who can expect a good improvement of their symptoms. Patients with chronic sinusitis / sinonasal polyposis not responding to medical treatment and with supportive Diagnostic Nasal Endoscopy and radiological findings were selected for the endoscopic sinus surgery. Totally 100 patients were included in the study.

Diagnostic Nasal Endoscopy:

All the patients were done diagnostic nasal endoscopy examination under local anaesthsia with 4% lignocaine with oxymetazoline solution. Findings were marked as per the Lund and MacKay[40] endoscopic appearance staging system.

Computed Tomography Scan of Paranasal sinuses:

Computed tomography of paranasal sinuses were evaluated and recorded as per the Lund and MacKay[40] radiologic staging system. Computed tomography scans were thoroughly studied and all the anatomical variants were recorded as per the Lund and MacKay[40] scoring system.

Surgical technique: All the cases were done with the following parameters

Surgeon: All the cases were done by senior faculty members of the Upgraded Institute of Otorhinolaryngoly

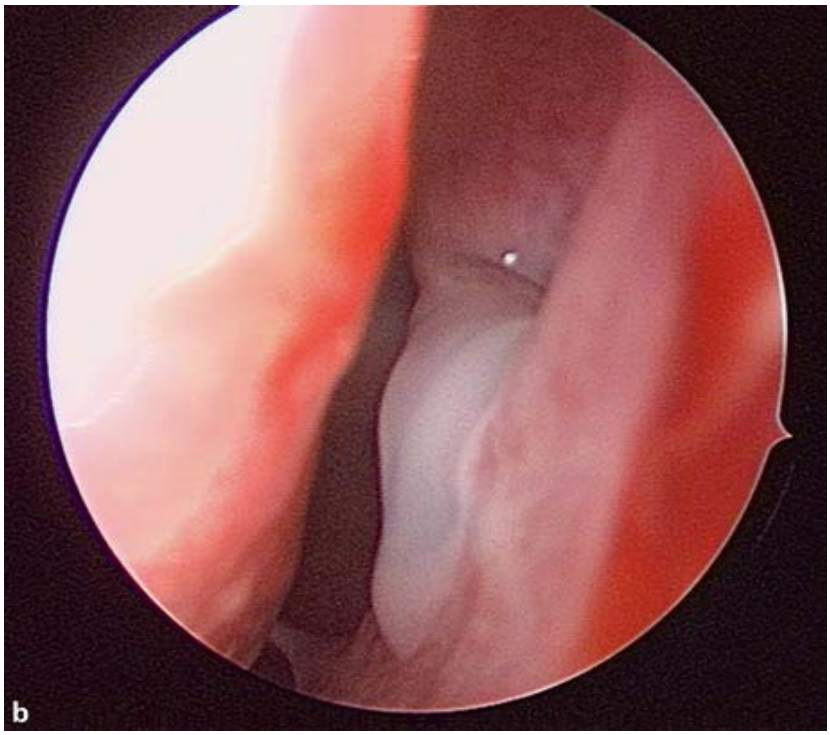
Anaesthesia: orotracheal intubation hypotensive general anaesthesia

Position: supine with 15°head end elevation

Pre operative nasal packing: 4% lignocaine with oxymetazoline

Local infiltration: 1% lignocaine with 1:100000 adrenaline

SINUSITIS



INSTRUMENTS FOR ENDOSCOPIC SINUS SURGERY

Video endoscopic system:

1. Karl Storz 0°, 30° and 45° rigid Hopkins rod nasal endoscopes
2. Karl Storz endovision camera
3. Karl Storz halogen bulb cold light source & light carrier cable

Instruments: Standard endoscopic sinus surgery instrument set.

No power shaving systems were used.

Surgical technique

The procedure is performed under hypotensive general anesthesia. The head end of the patient is elevated slightly to15° in reverse Trendelburg position. The nose is decongested and anesthetized with 4% lignocaine with oxymetazoline - soaked cotton pledgets placed in inferior meatus and middle meatus and left in place for 10 minutes. Throat packing was done.

Uncinate process:

It is extremely important to remove the uncinate process completely, extending from the superior attachment to the inferior cover over the maxillary antrum. Injection of 1% lignocaine, with 1/100,000 adrenaline, should be done 10 minutes before incision. The injections should be atraumatic and given in four places: at the superior lateral attachment of the middle turbinate, at the inferior anterior aspect of the uncinate process, at the inferior aspect of the middle turbinate, and at the posterior lateral attachment of the middle turbinate (at the ground or basal lamellae). Next, the maxillary sinus probe is used to

define and displace the uncinate process gently away from the hiatus semilunaris, setting it up for resection. The anterior attachment of uncinate process is incised with a sickle knife. The detached uncinate is grasped with a straight grasping Blakesly forceps and pulled down to its inferior attachment overlying the maxillary ostium. The inferior attachment is detached sharply using the Tru-cut forceps. Remaining pieces of the uncinate bone is removed to expose the hiatus semilunaris completely from the frontal recess to the ostium of the antrum. Any areas of polypoid mucosa, polyps or inflammatory debris are also gently removed.

Frontal recess:

Atraumatic probing of the frontal recess using the frontal ostium probe can be accomplished with removal of the uncinate. If the bulla ethmoidalis is intact, the anterior attachment is usually to the skull base and also forms the posterior boundary of the frontal recess. The frontal recess probe can be used as a dissector to displace polyps and polypoid changes from the recess for removal. It is important to preserve normal or minimally inflamed mucosa in the recess to avoid scarring of the recess. The use of a 30° or 45° telescope at this point is helpful in identifying the ostium and inspecting the area for complete dissection. If more than one opening is seen, the more medial opening is usually the frontal recess; the lateral opening is typically a supraorbital cell. This configuration can

be further confirmed with transillumination of the frontal sinus with the endoscope placed within the recess or with image-guidance technology.

Maxillary ostium:

The ostium is probed first with the antrum probe. If there are copious or thick secretions within the sinus, the ostium is gently dilated. If it is determined that a larger ostium is necessary, the straight endoscopic scissors is inserted and incised posteriorly. An alternative is to insert gently a curved 90° olive-tip suction to open carefully the maxillary sinus ostia posteriorly. The backbiting forceps is next used in the open position anterior to palpate the tissue. If the tissue anteriorly is bone, no further tissue is required for removal; this position is also roughly approximated by the anterior edge of the middle turbinate. Dissection further anterior can result in injury to the nasolacrimal duct.

Bulla ethmoidalis:

Besides being the entry into the anterior ethmoids, the bulla is important for locating the lamina papyracea. The lateral attachment of the bulla is on the lamina, and its identification can reduce the risk of orbital injury. The bulla is opened gently with an upturned small sinus curette, and the contents are inspected. It is important to use either Tru-cut forceps to avoid the stripping of normal mucosa, which will delay healing and cause scarring. Once the bulla is removed, it is important to define clearly the lamina papyracea and the basal lamella. Peribullar cells superiorly can also be removed at this point, clearly defining the anterior skull base and the frontal recess.

Posterior skull base:

A small opening is made through the ground (basal) lamella into the posterior ethmoid cells. An adequate opening is made into the posterior ethmoids with an upturned curette, curved suction, or ball-tip probe. This technique provides better tactile feedback. The dissection of the skull base is then performed in a posterior to anterior direction using the closed Blakesly forceps or ball-tip probe to dissect the inflammatory tissue and thin bony partitions. The removal of this tissue should be done with a Tru-cut forceps. These methods preserve normal mucosa and avoid mucosal stripping.

Sphenoid sinus:

The classic landmarks for location of the ostium are the choana and the attachment of the superior turbinate. One way to locate the sinus opening is to identify the superior turbinate. The inferior aspect of the turbinate is removed, and the ostium should be directly inferior. Another method of identifying the ostium is by looking 1.5 cm above the superior edge of the choana along the sphenoid face. The opening is made larger, usually with small upturned curettes or a low-profile 90° Kerrison. The ostium is always opened in an inferior and medial direction to avoid the more dangerous lateral wall of the sinus. The sinus mucosa within the sinus is not stripped for fear of endangering a dehiscent internal carotid artery.

Intraoperative bleeding and surgical field visibility was graded for all the cases and recorded with BOEZAART VAN DER MERWE Grading.

Grade 1 – Cadaveric conditions with minimal suction required

Grade 2 – Minimal bleeding with infrequent suction required.

Grade 3 – Brisk bleeding with frequent suction required

Grade 4 – Bleeding covers surgical field after removal of suction before the instrument can perform the task.

Grade 5 – Uncontrolled bleeding. Bleeding out of nostril on removal of suction.

The study group was tabled according to their grade of visibility during surgery.

Postoperative follow-up

Intranasal packing is used routinely with Merocel sponges. Packs are removed on the first postoperative day. Patient is put on parentral antibiotics for 3 days and discharged on 2nd postoperative day, unless there is any complication. Antibiotics are used for 3 weeks. Either systemic or topical steroids are employed, depending on severity and nature of the disease. Patients are also given oral antihistamine therapy to reduce any allergic component of their disease, if applicable.

The first postoperative visit is on 7th post operative day. At this time, any cultures obtained are checked, and antibiotics are adjusted as needed. An endoscopic examination with debridement is performed to remove any debris,

loose tissue or adhesions. At the second postoperative visit on 14th day, the patient is examined for the development of synechiae, which are opened at that time; stenting may be employed if there is risk of synechiae reformation. The third visit is on 28th day, when the mucosal status is reassessed, and inhaled nasal steroids are prescribed as indicated in the patients with sinonasal polyposis and nasal allergy. Follow- up thereafter is individualized for each patient. Post operatively all the patients were followed up for three months.

OBSERVATION

Observation of 100 patients who underwent endoscopic sinus surgery is as follows.

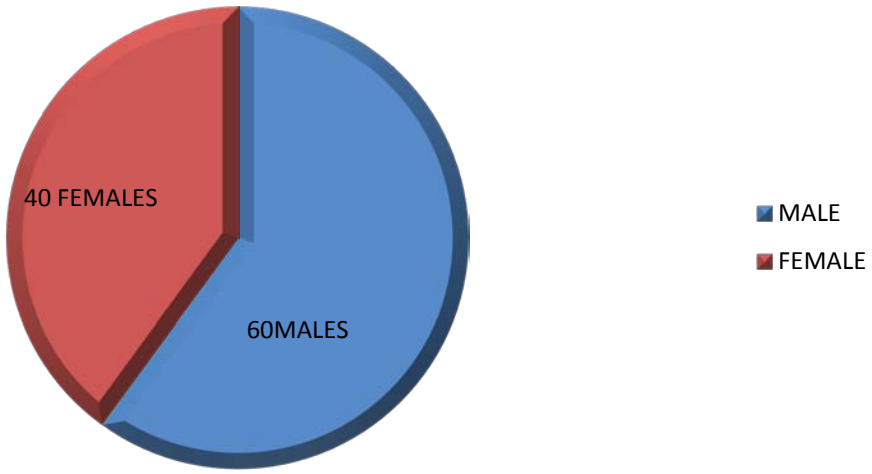
1. **Age & Sex incidence:**

   Age of the patients participated in this study is from 14 years to 60 years.out of 100 patients, 60 were males (60%) and 40 were females (40%)

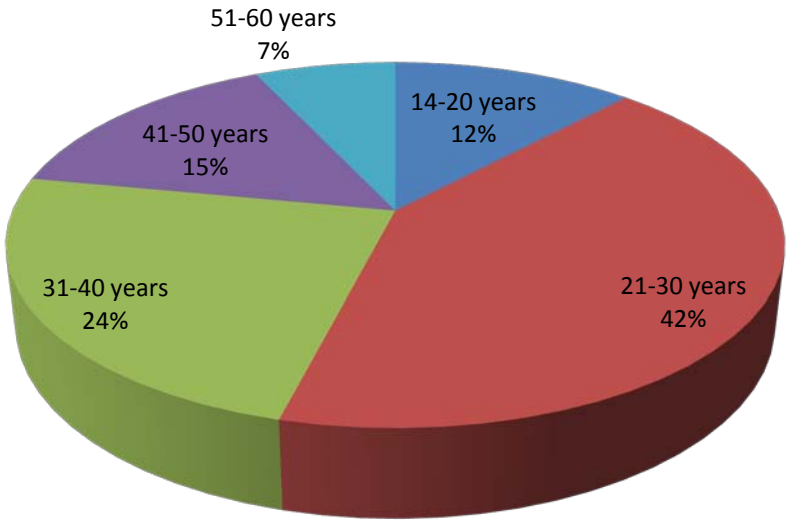
TABLE – 1

Age group	Males	Females	Total
14 – 20 years	8	4	**12**
21 – 30 years	26	16	**42**
31 – 40 years	14	10	**24**
41 -50 years	8	7	**15**
51 -60 years	4	3	**7**
Total	**60**	**40**	**100**

SEX RATIO



AGE DISTRIBUTION



2. Prior medical treatment

All the patients received extensive medical treatment prior to surgery. 84% received antihistamines, 72% received nasal decongestants, 40% received steroids and everyone received at least one course of antibiotics.

Prior medical treatment	patients
Anti histamines	84%
Decongestants	72%
Steroids	40%
Antibiotics	100%

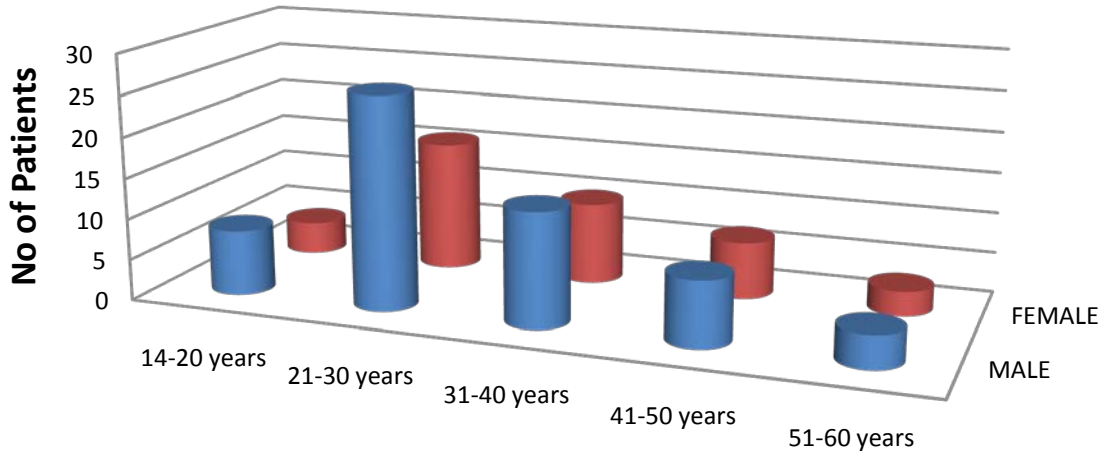
Computed tomography scan of paranasal sinuses and Diagnostic Nasal Endoscopy was done for all the patients and details were noted.

Anatomical variants:

The common anatomical variant noted was concha bullosa which was found on 39% of the patients, followed by paradoxical middle turbinate in 21% of patients, haller cells in 16%, agger nasi in 15% and everted uncinate process in 5% of the patients.

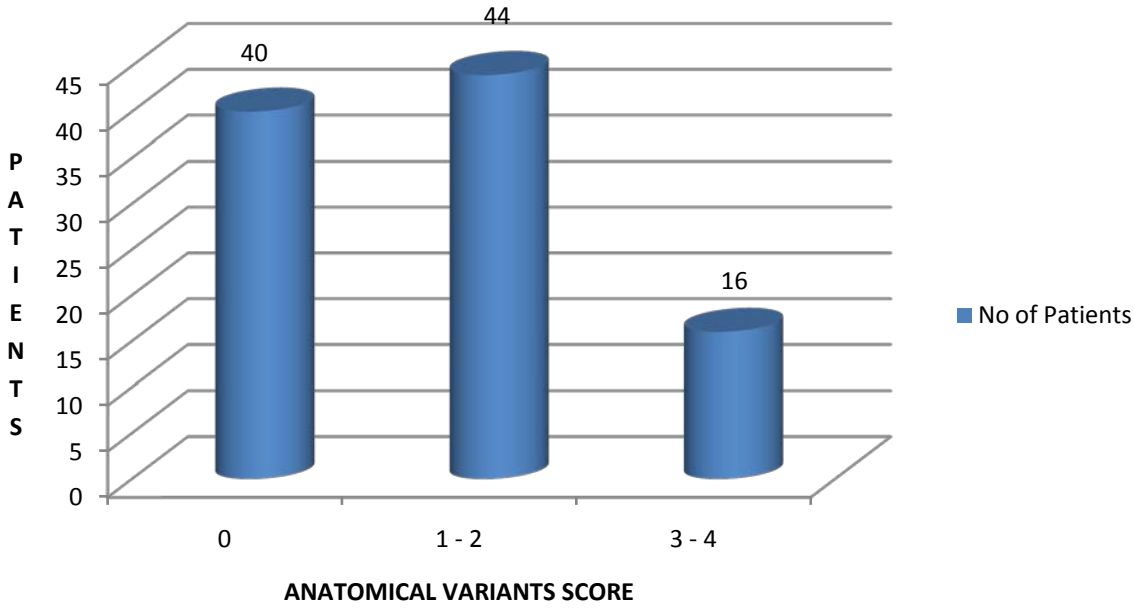
Anatomical variation score: Maximum of 4 in 3% of cases, 3 in 13% of cases, 2 in 24% of cases and score 1 in 20% of cases.

SEX DISTRIBUTION



	14-20 years	21-30 years	31-40 years	41-50 years	51-60 years
MALE	8	26	14	8	4
FEMALE	4	16	10	7	3

ANATOMICAL VARIANTS SCORE

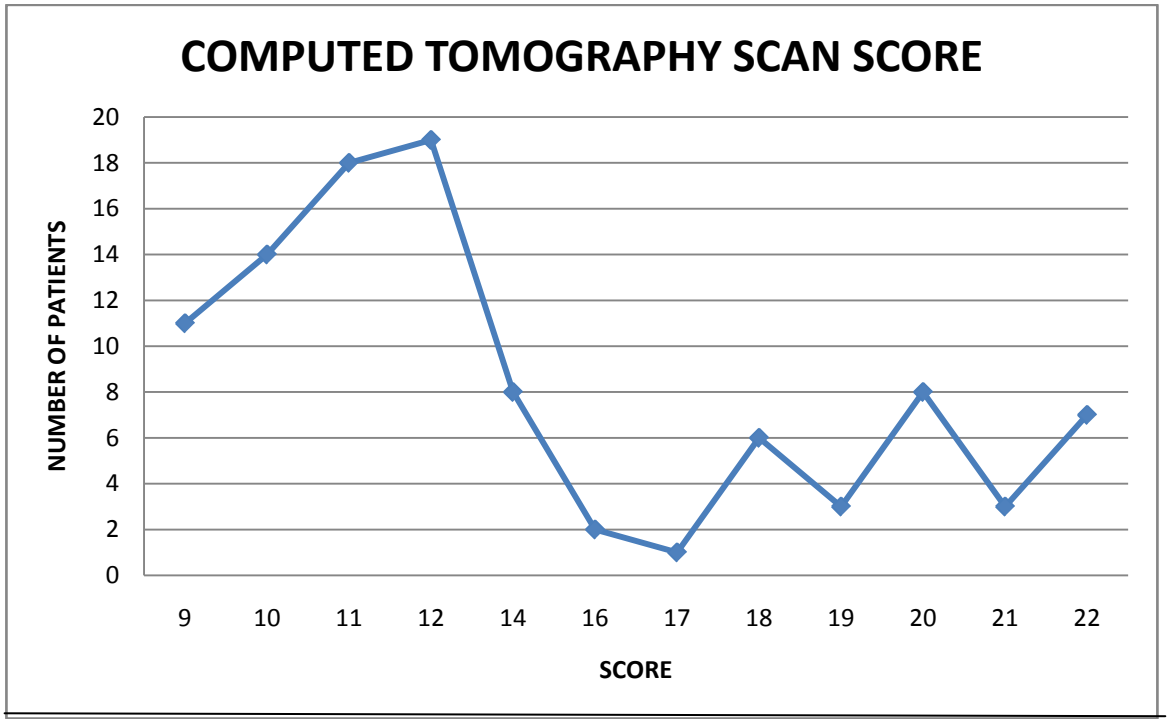


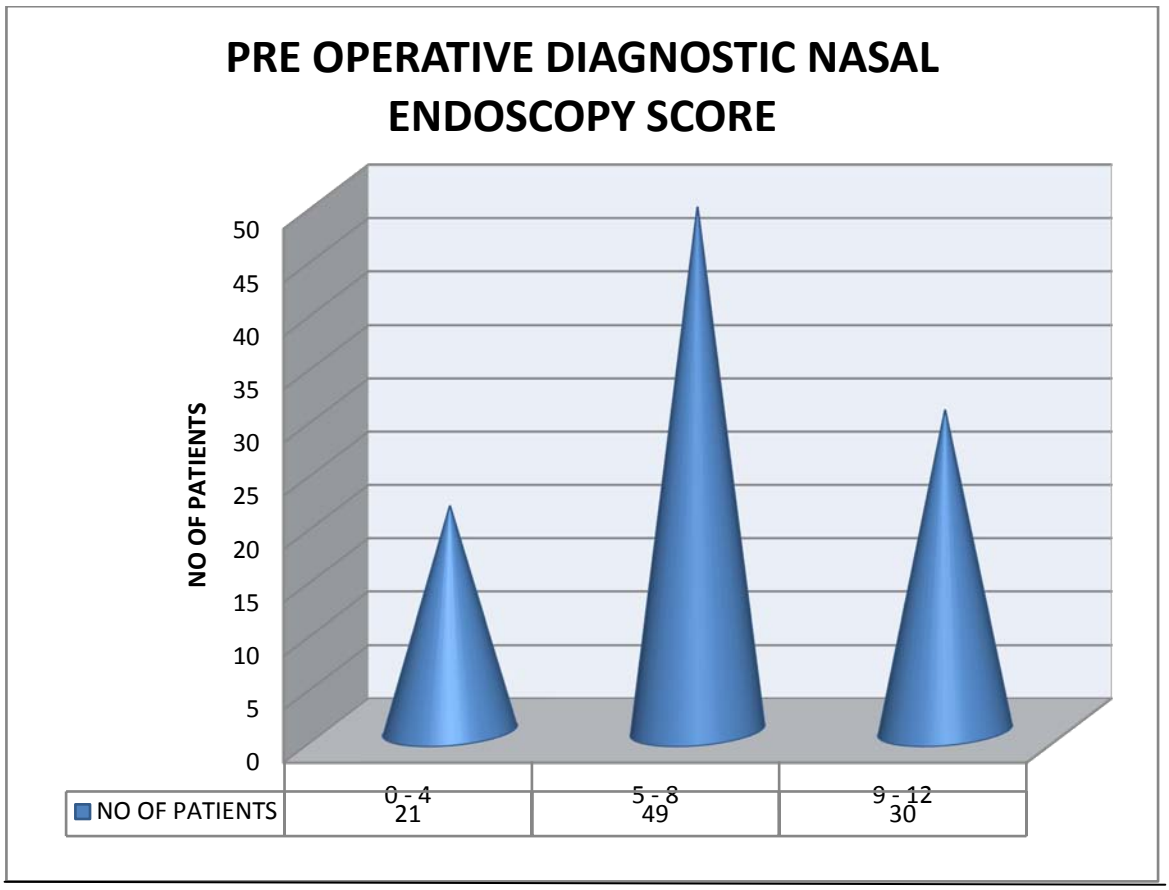
Anatomical variations score	**% of patients**
3 - 4	16
1 - 2	44
0	40

Computed Tomography Scan score:

According to the Lund – MacKay scoring system, the score was ranging from 22 to 9.

Computed Tomography Score	Percentage of patients
22	7
21	3
20	8
19	3
18	6
17	1
16	2
14	8
12	19
11	18
10	14
9	11


COMPUTED TOMOGRAPHY SCAN SCORE
NUMBER OF PATIENTS
20
18
16
14
12
10
8
6
4
2
0
9
10
11
12
14
16
17
18
19
20
21
22
SCORE


PRE OPERATIVE DIAGNOSTIC NASAL ENDOSCOPY SCORE
NO OF PATIENTS
50
45
40
35
30
25
20
15
10
5
0
NO OF PATIENTS
0 - 4
21
5 - 8
49
9 - 12
30

Diagnostic Nasal Endoscopy Score:

DNE Score	No of patients
0 - 4	21
5- 8	49
9 - 12	30

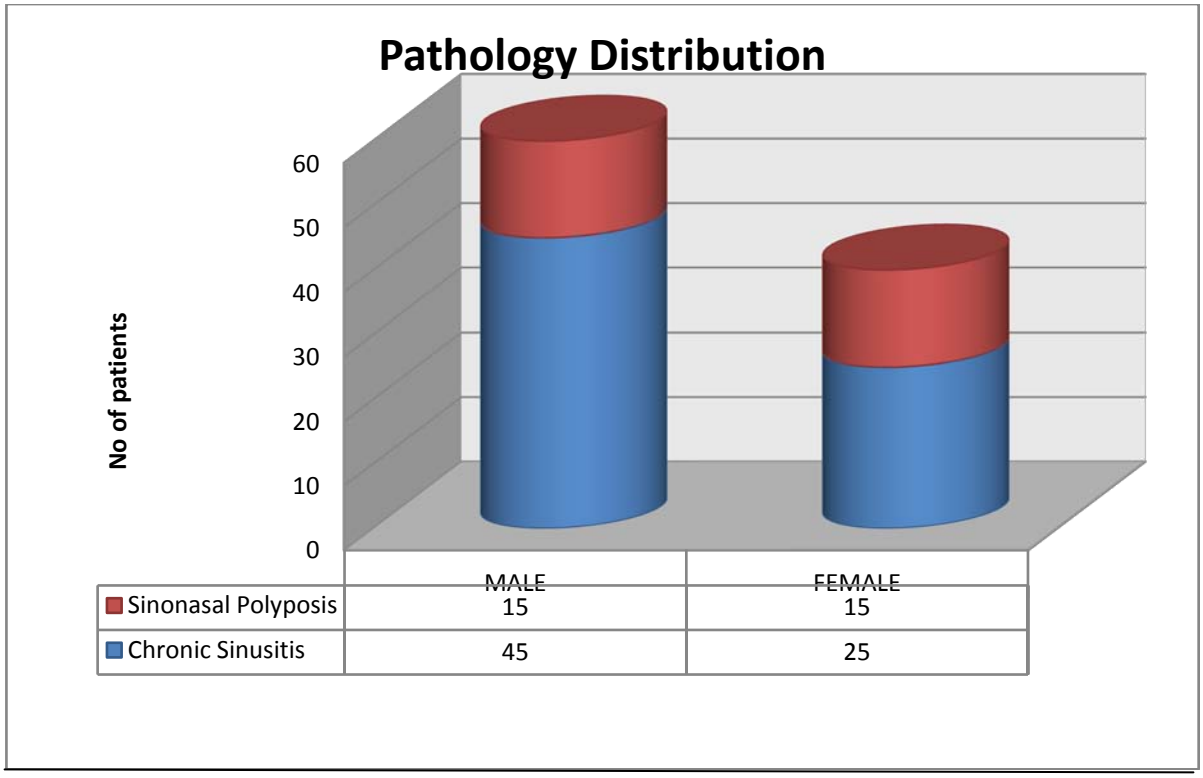
Pathology:

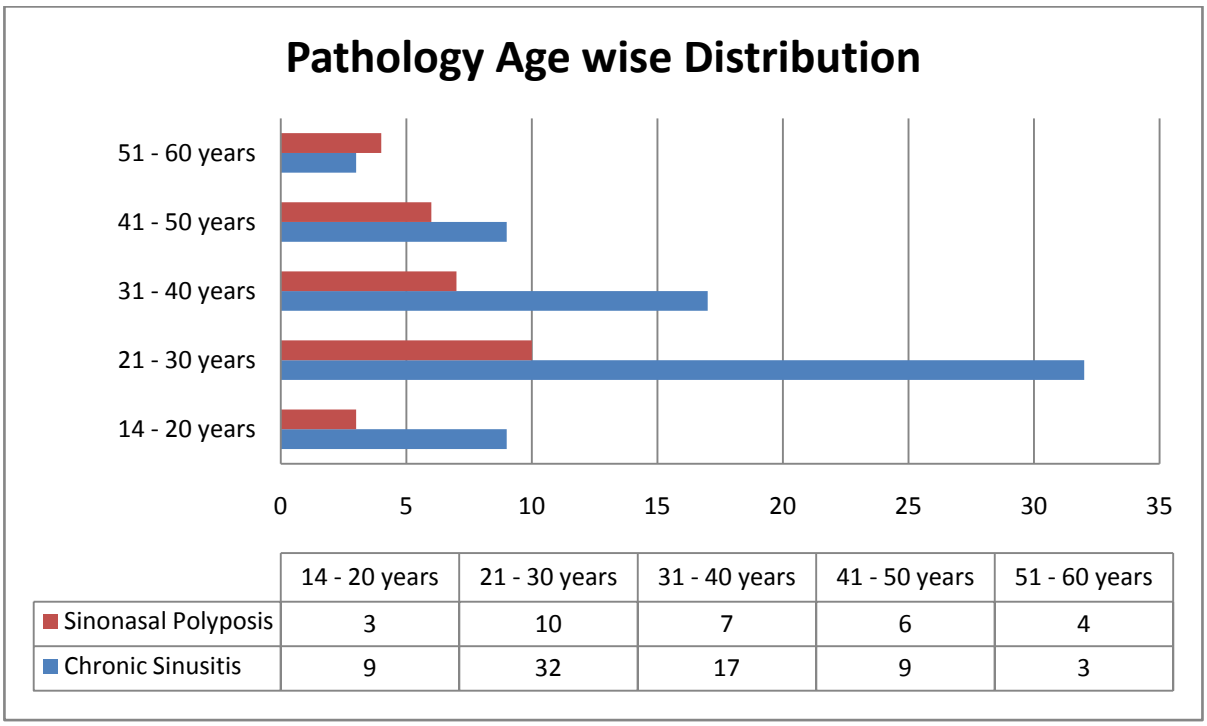
We had sixty cases of chronic sinusitis and forty cases of sinonasal polyposis, with involvement of various sinuses.

Anaesthesia: All the surgeries were done under hypotensive general anaesthesia.

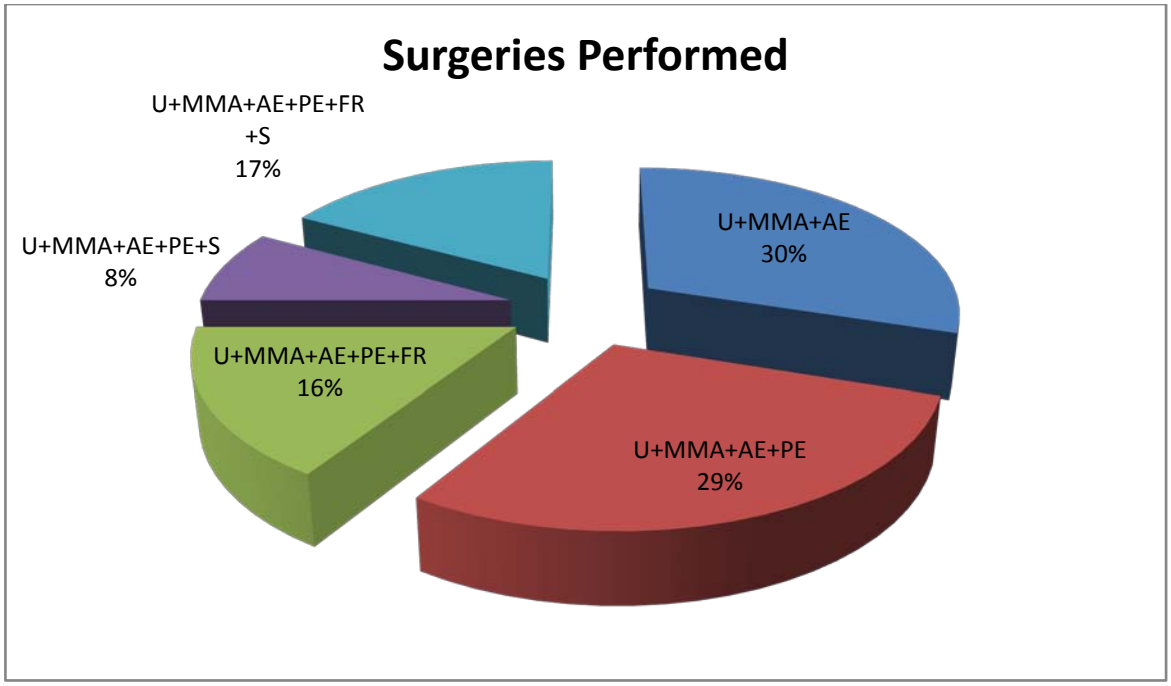
Surgery performed:

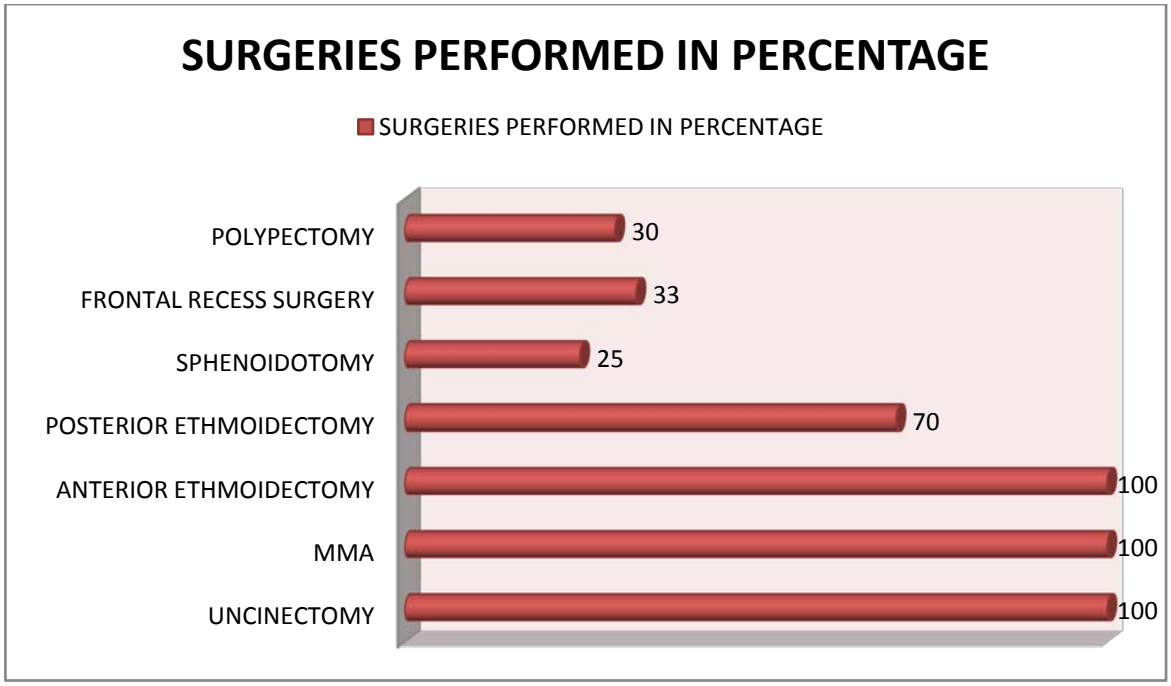
Surgery	Percentage of patients
Uncinectomy	100
Middle meatal antrostomy	100
Anterior ethmoidectomy	100
Posterior ethmoidectomy	70
Sphenoidectomy	25
Frontal recess surgery	33
Reduction of the middle turbinate	0





	14 - 20 years	21 - 30 years	31 - 40 years	41 - 50 years	51 - 60 years
Sinonasal Polyposis	3	10	7	6	4
Chronic Sinusitis	9	32	17	9	3


Surgeries Performed
U+MMA+AE+PE+FR
+S
17%
U+MMA+AE+PE+S
8%
U+MMA+AE
30%
U+MMA+AE+PE+FR
16%
U+MMA+AE+PE
29%


SURGERIES PERFORMED IN PERCENTAGE
SURGERIES PERFORMED IN PERCENTAGE
POLYPECTOMY
30
FRONTAL RECESS SURGERY
33
SPHENOIDOTOMY
25
POSTERIOR ETHMOIDECTOMY
70
ANTERIOR ETHMOIDECTOMY
100
MMA
100
UNCINECTOMY
100

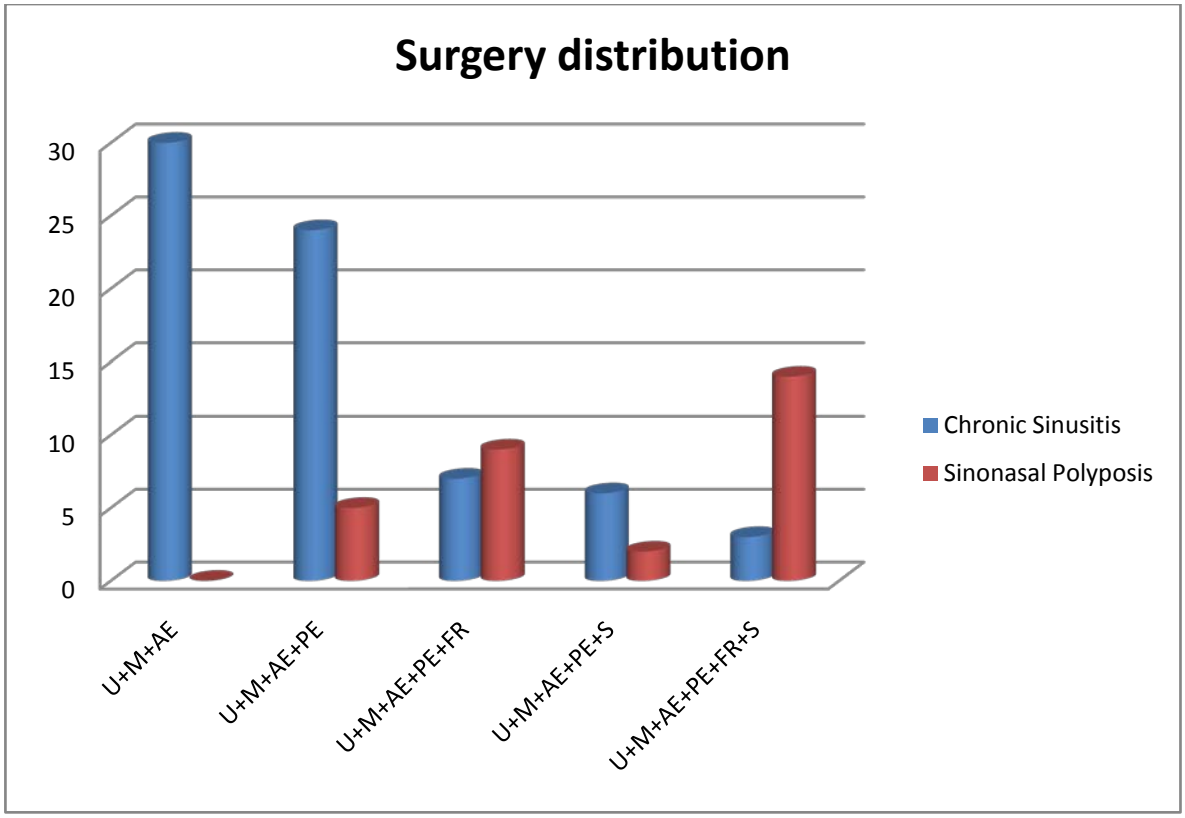
All the patients had undergone uncinectomy and middle meatal antrostomy. 30% of the patients underwent anterior ethmoidectomy in addition to uncinectomy and middle meatal antrostomy. 29% of the patients underwent posterior ethmoidectomy also in addition to the above. 16% of the patients underwent frontal recess surgery in addition to uncinectomy, middle meatal antrostomy, anterior and posterior ethmoidectomy. 8% of the patients underwent sphenoidotomy in addition to uncinectomy, middle meatal antrostomy, anterior and posterior ethmoidectomy. 17% of the patients underwent uncinectomy, middle meatal antrostomy, anterior and posterior ethmoidectomy, frontal recess surgery and sphenoidotomy.

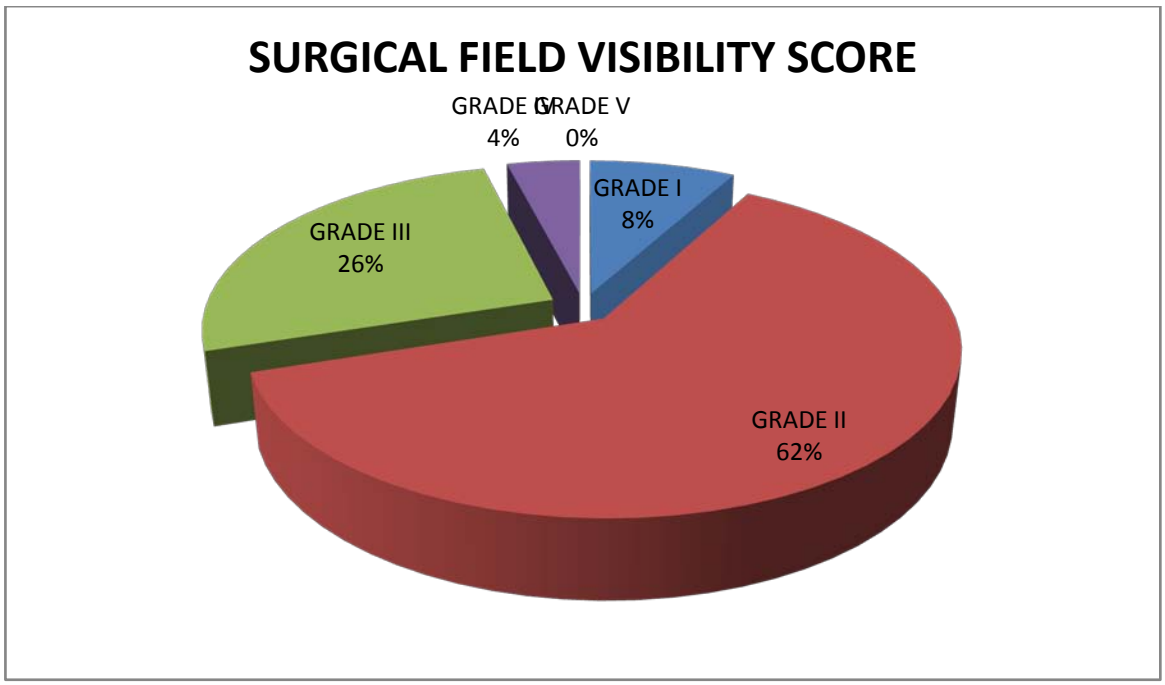
Intraoperative bleeding and surgical field visibility was graded.

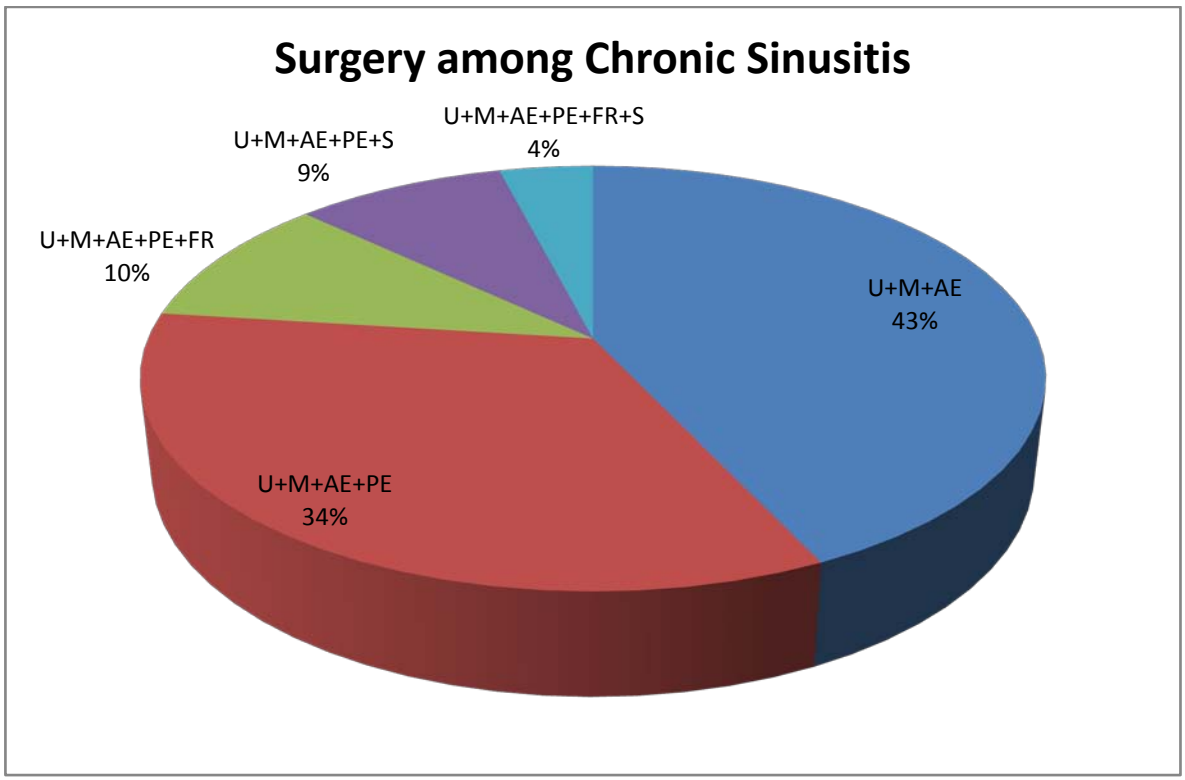
BOEZAART VAN DER MERWE surgical field visibility Grading

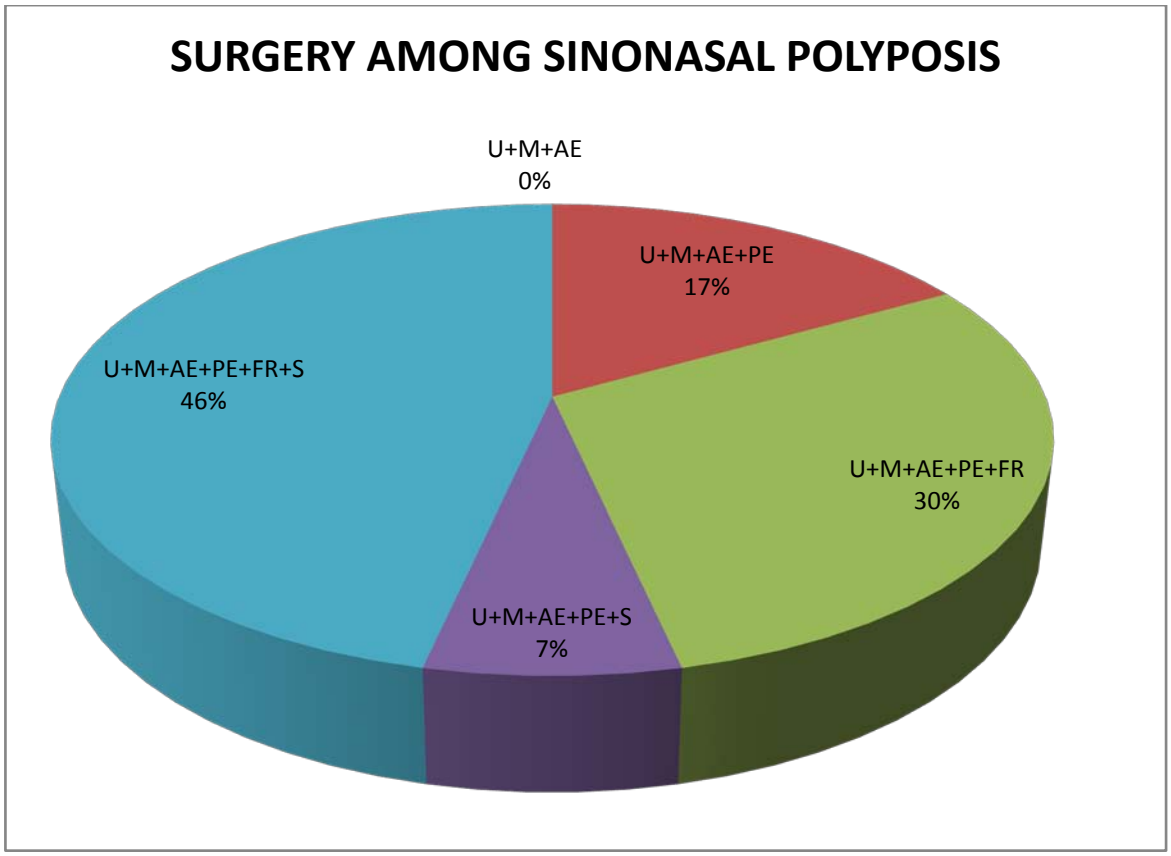
Grade	***No of Patients***
Grade I	8
Grade II	62
Grade III	26
Grade IV	4
Grade V	0

8% of patients had cadaveric conditions like surgical field with minimal suction, 62% had Grade 2 visibility with infrequent suctioning, 26% had Grade 3 visibility with frequent suctioning and 4% had Grade 4 surgical field visibility.


Surgery distribution
30
25
20
15
10
5
0
U+M+AE
U+M+AE+PE
U+M+AE+PE+FR
U+M+AE+PE+S
U+M+AE+PE+FR+S
Chronic Sinusitis
Sinonasal Polyposis


SURGICAL FIELD VISIBILITY SCORE
GRADE IV
4%
GRADE V
0%
GRADE I
8%
GRADE III
26%
GRADE II
62%

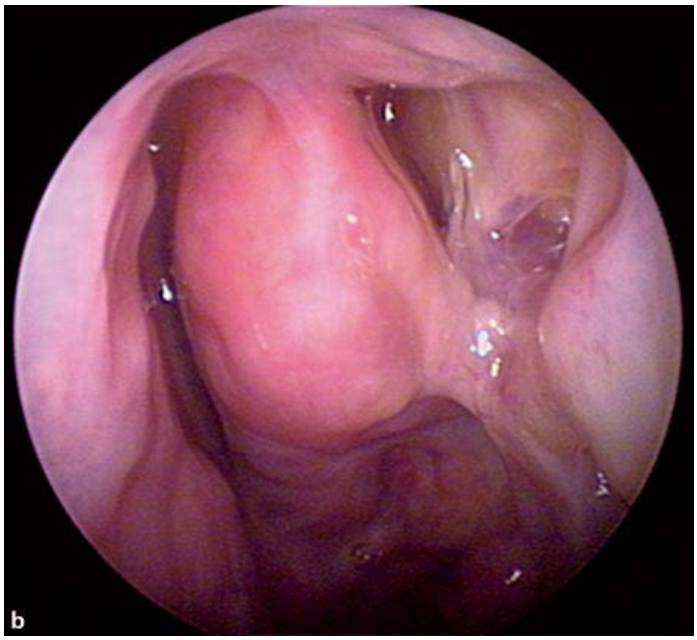

Surgery among Chronic Sinusitis
U+M+AE+PE+FR+S
4%
U+M+AE+PE+S
9%
U+M+AE+PE+FR
10%
U+M+AE
43%
U+M+AE+PE
34%

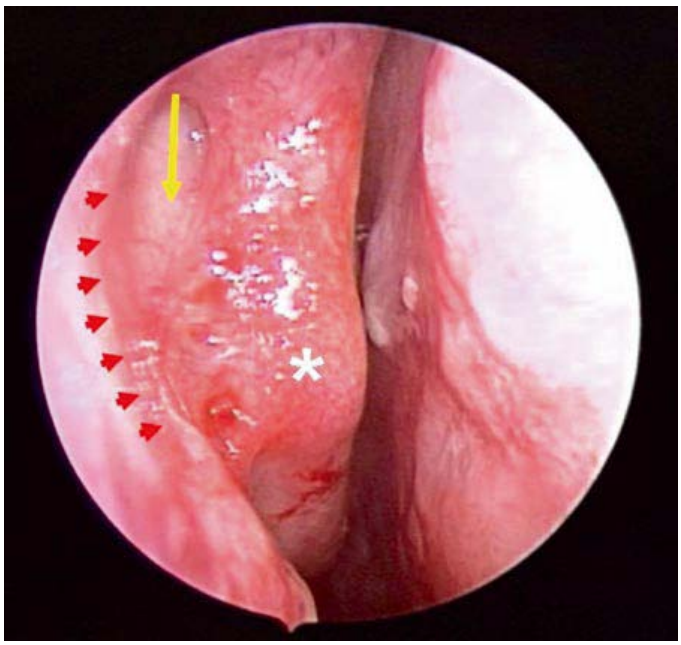

SURGERY AMONG SINONASAL POLYPOSIS
U+M+AE
0%
U+M+AE+PE
17%
U+M+AE+PE+FR+S
46%
U+M+AE+PE+FR
30%
U+M+AE+PE+S
7%

Complications:

Category	***Complication***	***No of patients***		***percentage***	***Management***
		male	***female***		
Major	Orbital haematoma (post septal)	0	0	0	
	Loss of vision	0	0	0	
	Diplopia	0	0	0	
	CSF leak	1	0	1	Endoscopic closure
	Meningitis	0	0	0	
	Brain abscess	0	0	0	
	Focal brain damage	0	0	0	
	Haemorrhage requiring transfusion	0	0	0	
	Carotid artery injury	0	0	0	
	Epiphora	0	0	0	
	Blindness	0	0	0	
	CNS deficits	0	0	0	
	Death	0	0	0	
Minor	Periorbital emphysema	1	0	1	Conservative
	Periorbital ecchymosis	1	0	1	Conservative
	Dental or lip pain or numbness	0	0	0	
	Adhesions requiring treatment	5	3	8	
	Epistaxis requiring packing	1	1	2	
	Bronchospasm	0	0	0	
	Sinus infection	0	0	0	
	Dental or lip pain or numbness or anosmia	0	0	0	

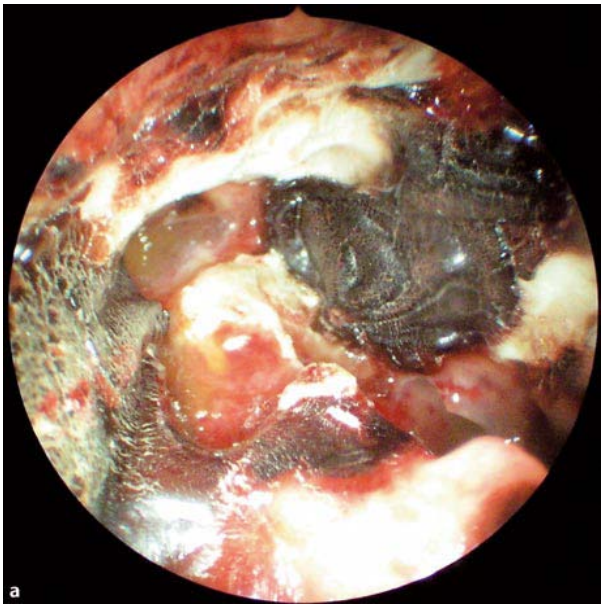
POST OPERATIVE ADHESIONS





POST OPERATIVE CRUSTS

POST OPERATIVE DNE 7TH DAY



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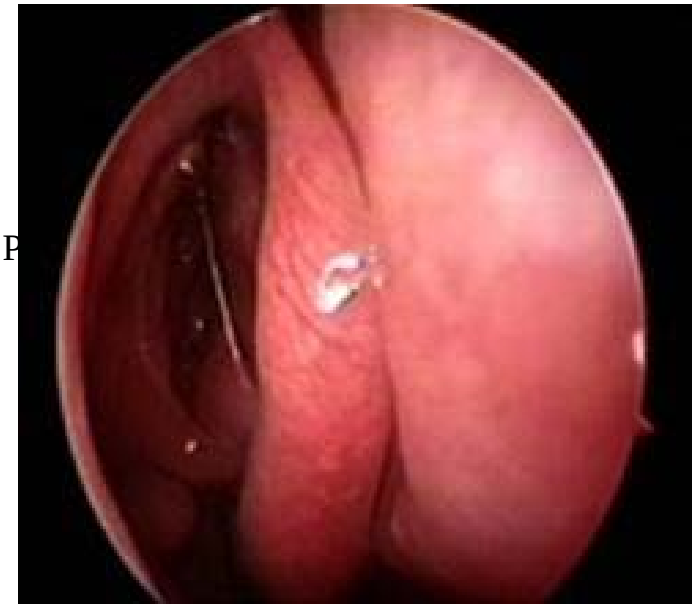


We had one major complication in this study. Cerebrospinal Fluid leak occurred post operatively in a case of extensive sinonasal polyposis, involving all the paranasal sinuses. The patient was taken up for the surgical correction of the defect. He underwent endoscopic Cerebrospinal fluid leak closure after one week. He was discharged from the hospital on 14th day without any residual problems.

We had 12 cases of minor complications, most of them are adhesions that occurred in 8 patients, 3 patients presented on the 7th post operative day and 5 others on 14th post operative day. Out of these 8 patients, only 3 had symptomatic nasal block. All the cases were managed by release of adhesions under local anaesthesia, and careful frequent post operative follow up.

We had one each case of periorbital ecchymosis and periorbital emphysema, which was managed conservatively. Anterior nasal packs were removed immediately. Vision and eye movements were normal. A course of steroids were given. Patient was discharged on 7th post operative day without any sequelae.

We had two cases of bleeding, one on the table which was controlled with the post nasal pack in addition to anterior nasal pack and another one which was on 4th post operative day, which was managed with anterior nasal pack.

PERIORBITAL EMPHYSEMA

PERIORBITAL ECCYMOSIS

Surgery	No of patients	Complications		Percentage
		Major	Minor	
MMA+AE	30	0	0	0
MMA+AE+PE	29	0	1	3.4
MMA+AE+PE+F	16	0	3	18.8
MMA+AE+PE+S	8	0	1	12.5
MMA+AE+PE+F+S	17	1	7	47

Anatomical variations score	No of patients	Complications		percentage
		Major	Minor	
0	40	0	3	7.5
1-2	44	0	6	13.7
3-4	16	1	3	25

Pathology	No of patients	Complications		percentage
		Major	Minor	
Chronic Sinusitis	70	0	4	5.8
Sinonasal Polyposis	30	1	8	30

Most of the complications occurred in the patients with extensive disease pathology and paranasal sinus anatomical variations.

DISCUSSION

Endoscopic sinus surgery is being done routinely in large number for the cases of chronic sinusitis, who fail medical therapy and for sinonasal polyposis. Patient selection involves a thorough history and physical examination, a trial with medical management, diagnostic nasal endoscopy and CT scan of the paranasal sinuses.

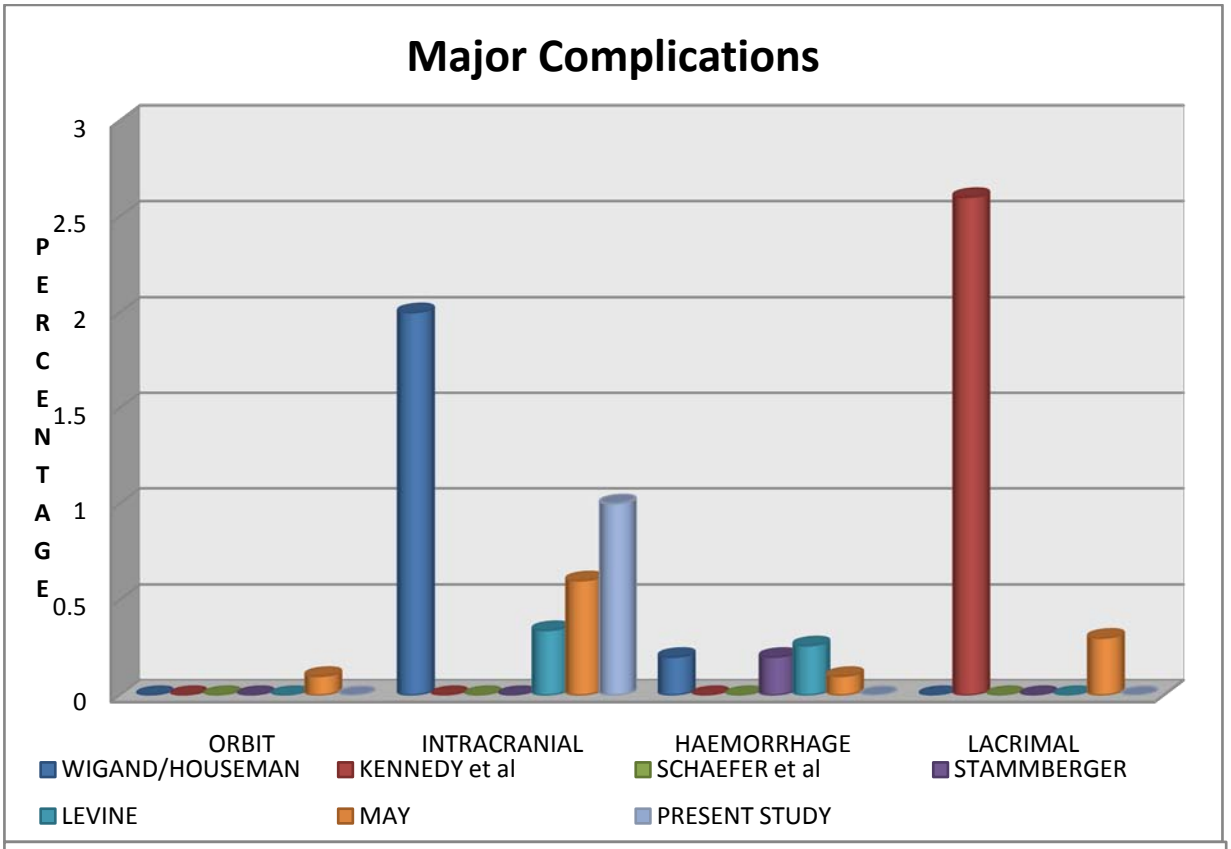
This study of 100 patients over the study period from July 2008 to September 2009 included 60 males and 40 females. Patients with chronic sinusitis, refractory to the medical treatment and sinonasal polyposis were taken into the study. Patients with bleeding diathesis, tumors, sellar leions, and orbital lesions were excluded from the study. Maximum number of patients belonged to the 21 – 30 years of age group. In this group, there were 26 males and 16 females. 70 patients were diagnosed as chronic sinusitis and 30 patients had sinonasal polyposis.

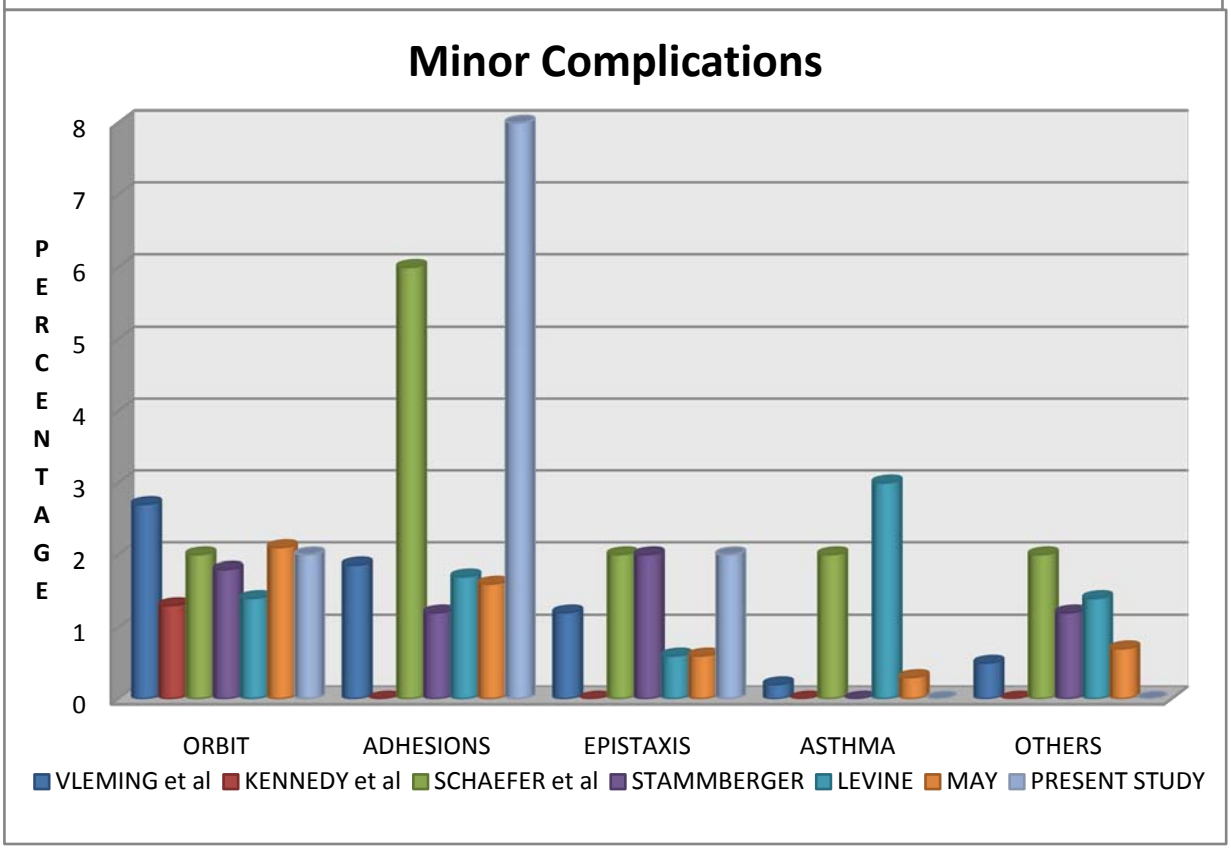
The extent of the surgery depends upon the extent of the disease pathology. 30% of the patients underwent anterior ethmoidectomy in addition to uncinectomy and middle meatal antrostomy. 29% of the patients underwent posterior ethmoidectomy also in addition to the above. 16% of the patients underwent frontal recess surgery in addition to uncinectomy, middle meatal antrostomy, anterior and posterior ethmoidectomy. 8% of the patients underwent sphenoidotomy in addition to uncinectomy, middle meatal antrostomy, anterior

and posterior ethmoidectomy and 17% of the patients underwent uncinectomy, middle meatal antrostomy, anterior and posterior ethmoidectomy, frontal recess surgery and sphenodotomy. We had one case of CSF rhinorrhoea, which is a major complication, and was managed surgically and the patient was discharged without any sequelae. This complication occurred in a case of bilateral extensive polyposis involving all the paranasal sinuses. The incidence of major complication is 1% in this study. The overall incidence of major complications in the study of May[28] was 1.2% and by Levine was 0.85%. The overall average of incidence in internationally published studies is 1.1%. We didn't come across any major complications involving orbit in our study.

In the minor complications, we had 12 cases of minor complications; most of them are adhesions that occurred in 8 patients that come to 8%. All the cases were managed by release of adhesions under local anaesthesia, and careful frequent post operative follow up. Most of the adhesions occurred in the cases of extensive disease.

We had one each case of periorbital ecchymosis and periorbital emphysema, which was managed conservatively, and comes to 2% of minor orbital complications. We had two cases of bleeding. Minor complication of bleeding occurred in 2% of cases. Total minor complications rate in our study is 12%. The incidence of minor complications as reported by May is 5.4% and by Levine is 8%.


Major Complications
PERCENTAGE
3
2.5
2
1.5
1
0.5
0
ORBIT
INTRACRANIAL
HAEMORRHAGE
LACRIMAL
WIGAND/HOUSEMAN
KENNEDY et al
SCHAEFER et al
STAMMBERGER
LEVINE
MAY
PRESENT STUDY


Minor Complications
PERCENTAGE
8
7
6
5
4
3
2
1
0
ORBIT
ADHESIONS
EPISTAXIS
ASTHMA
OTHERS
VLEMING et al
KENNEDY et al
SCHAEFER et al
STAMMBERGER
LEVINE
MAY
PRESENT STUDY

Complications of endoscopic sinus surgery procedures reported

Study	Total patients	***Major*** (No. of patients with complications)			
		Orbit	Intra cranial	Haemorrhage	Lacrimal
Wigand / hosemann	500	-	10	1	-
Kennedy et al	75	-	-	-	2
Schaefer et al	100	-	-	-	-
Toffel et al	170	-	-	1	-
Rice	100	-	-	-	-
Vleming et al	593	2	2	2	1
Stammberger	500	-	-	1	-
Posawetz	4500	2	3	-	-
Matthews et al	155	-	-	-	-
Lazar et al	210	-	-	-	3
stankiewicz	90	1	1	-	-
stankiewicz	90	-	1	-	-
Total	2583	3	14	5	6
Incidences		0.12%	0.54%	0.19%	0.23%
Overall incidence of major complications: 28/2583= 1.1%					
Levine	1165	-	4	3	-
Incidence			0.34%	0.26%	
Incidence of major complications: 7/1165= 0.6%					
May	943	1	6	1	3
Incidence		0.1%	0.6%	0.1%	0.3%
Incidence of major complications: 11/943= 1.2%					
Total	2108	1	10	4	3
Incidence		0.05%	0.47%	0.19%	0.14%
Overall Incidence of Major Complications: 18/2108= 0.85%					

Study	Total patients	***Minor*** (No. of patients with complications)				Other
		Orbit	Adhesion	Epistaxis	asthma	
Wigand / hosemann	500	Not reported				
Kennedy et al	75	1	-	-	-	-
Schaefer et al	100	2	6	2	2	2
Toffel et al	170	-	1	5	-	-
Rice	100	3	7	-	-	-
Vleming et al	593	16	11	7	1	3
Stammberger	500	9	6	10	-	6
Posawetz	4500	Not reported				
Matthews et al	155	-	-	3	-	-
Lazar et al	210	5	-	8	-	3
stankiewicz	90	8	6	5	-	1
stankiewicz	90	1	-	-	-	-
Total		45	37	40	3	15
Incidence		1.7%	1.4%	1.6%	0.12%	0.58%
Overall incidence of minor complications: 140/2583= 5.4%						
Levine	1165	16	20	7	35	16
Incidence		1.4	1.7	0.6%	3%	1.4%
Incidence of minor complications: 94/1165= 8%						
May	943	20	15	6	3	7
Incidence		2.1%	1.6%	0.6%	0.3%	0.7%
Incidence of minor complications: 51/943= 5.4%						
Total	2108	36	35	13	38	23
Incidence		1.7%	1.7%	0.6%	1.8%	1%
Overall Incidence of Minor Complications: 145/2108= 6.9%						

In the first U.S. study that quantified complications related to endoscopic sinus surgery, Stankiewicz, reported a 6% major and 13% minor complication rate, the most common being synechiae. In a follow-up study, Stankiewicz[29] reported on the complication rate of a subsequent group of 90 patients, and noted a rate of 2.4%, which compared favorably with previous reports of complications as reported by Freedman and Kern in 1979 using conventional intranasal methods. This significant drop in the complication rate was attributed to greater operative experience, concurrent cadaveric dissection, and the use of limited ethmoidectomy initially, with gradual progression to more extensive procedures. Several studies have subsequently demonstrated a further decline in the incidence of complications. Dessi noted a 1.2% complication rate for overall complications.

The complications both major and minor in this study are comparable to the international standards.

CONCLUSION

Even though a lot of endoscopic sinus surgeries are being done nowadays, the complications do occur.

1. We had 1% of major complications and 12% of minor complications in this study.
2. Major factors influencing the occurrence of complications are extension of the disease pathology and anatomical variations of the paranasal sinuses.
3. Analysis of complications shows the following surgical principles will reduce the occurrence of the complications.
    a) Preoperative evaluation of the patient and thorough study of the extension of disease pathology and anatomical variants in Computed Tomography Paranasal Sinuses.
    b) For successful endoscopic sinus surgery, a clear understanding of the anatomy is vital. Knowledge of the anatomic relationships and variations helps surgeons avoid complications.
    c) Identification of key anatomic landmarks helps prevent complications.
    d) The preservation of sinus mucosa helps prevent scarring.
    e) Careful handling of tissues intra operatively can help reduce postoperative problems such as synechiae.
    f) Good haemostasis can be achieved with careful preliminary decongestion and infiltration of a vasoconstrictive agent. In addition,

keeping the patient's mean arterial blood pressure below 80 mm Hg, as tolerated, will reduce the risk of bleeding intra operatively.

g) Periodic irrigation with saline during surgery helps improve visualization of vital anatomic structures. Endoscope scrubbing attachments can also be use to optimize visualization.

h) Advancement of technology has provided us good video endoscopic system with various angled telescopes and high illumination to look into all the corners and hidden places. These advanced technologies and proper surgical instruments definitely have a role in the outcome.

i) Proper training of the residents by senior faculties & courses of cadaver dissection makes a big difference

4. Most of the complications are minor ones, that are managed conservatively and the patients can be discharged without any sequelae. But major complications like extensive bleeding, intracranial and an orbital complication which endangers vision requires immediate attention to prevent permanent morbidity and mortality. Ostrich like attitude will not help in managing the major complications in any way better.

By applying anatomic knowledge with careful surgical technique, one can maximize patient safety. Basic tenets for endoscopic sinus surgery can be applied to a variety of patients with confidence.

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PROFORMA

SERIAL NO

Name :

Age & Sex :

Occupation :

OP / IP No :

History :

Complaints

1.
2.
3.
4.

H/o Allergy

Food / Inhalant

Seasonal / Perennial

Past History:

1. Hypertension
2. Diabetes Mellitus
3. Bronchial Asthma
4. Bleeding disorders

Treatment History:

1. Antibiotics
2. Anti Histamines
3. Steroids – Systemic / Intra nasal
4. Decongestants – Systemic / Topical
5. Aspirin / NSAIDs & others

H/o previous surgery / Anaesthesia

Clinical Examination:

Nose :

1. Anterior Rhinoscopy
2. Posterior Rhinoscopy
3. Para Nasal Sinus Tenderness
4. Cold Spatula Test

Ears :

Throat :

Pre Operative Diagnostic Nasal Endoscopy:

CHARACTERISTIC	Right	Left
Polyp (0,1,2,3)[a]		
Oedema (0,1,2,)[b]		
Discharge (0,1,2)[c]		

[a] 0 = Absence of polyps; 1 = polyps in middle meatus only;

2 = polyps beyond middle meatus but not blocking the nose completely;

3 = polyps completely obstructing the nose

[b] Oedema: 0 = absent; 1 = mild; 2 = severe

[c] Discharge: 0 = no discharge; 1 = clear, thin discharge; 2 = thick, purulent discharge

CT Scan – Para Nasal Sinuses

Lund-MacKay scoring system: CT scoring system

SINUS SYSTEM	RIGHT	LEFT
Maxillary (0,1,2)		
Anterior ethmoids (0,1,2)		
Posterior ethmoids (0,1,2)		
Sphenoid (0,1,2)		
Frontal (0,1,2)		
Ostiomeatal complex (0 or 2 only)*		
Total points		

0 = no abnormalities; 1 = partial opacification; 2 = total opacification

*0 = not occluded, 2= occluded

Radiological grading of anatomic variants

Lund-MacKay scoring system:

Anatomic variant	Right	Left
frontal sinus		
Concha bullosa		
Paradoxical middle turbinate		
Everted uncinate process		
Haller cells		
Agger nasi cells		
Total points		

Scoring: 0 = no variant, 1 = variant present

Surgical Details:

Anaesthesia: Orotracheal intubation General Anaesthesia

Hypotensive anaesthesia

Lund-MacKay scoring system: surgery scores

Surgery	Right	Left
Uncinectomy		
Middle meatal antrostomy		
Anterior ethmoidectomy		
Posterior ethmoidectomy		
Sphenoidotomy		
Frontal recess surgery		
Reduction of the middle turbinate		
Total points each side		

Score: 0 = no procedure done; 1 = surgery done.

The maximum score is 14 (7 each side)

Blood Transfusion:

The surgical field visibility- BOEZAART VAN DER MERWE Grading

GRADE I / II / III / IV / V

Complications:

Category	***Complication***	***Post op Day of development***	***Management***
Major	Orbital haematoma (post septal)		
	Loss of vision		
	Diplopia		
	CSF leak		
	Meningitis		
	Brain abscess		
	Focal brain damage		
	Haemorrhage requiring transfusion		
	Carotid artery injury		
	Epiphora		
	Blindness		
	CNS deficits		
	Death		

Category	***Complication***	***Post op Day of development***	***Management***
Minor	Periorbital emphysema		
	Periorbital ecchymosis		
	Dental or lip pain or numbness		
	Adhesions requiring treatment		
	Epistaxis requiring packing		
	Bronchospasm		
	Sinus infection		
	Dental or lip pain or numbness or anosmia		

ABBREVIATIONS

AE	: Anterior Ethmoidectomy
ANP	: Anterior Nasal Packing
B	: Bleeding
CSF	: Cerebrospinal Fluid
CONSER	: Conservative
END. CLOSE	: Endoscopic Closure
F	: Female
FR	: Frontal Recess Surgery
M	: Male
MA	: Middle Meatal Antrostomy
OMC	: Osteo Meatal Complex
P	: Polypectomy
PE	: Posterior Ethmoidectomy
P.ECC	: Periorbital Eccymosis
P.EMP	: Periorbital Emphysema
PNP	: Post Nasal Packing
S	: Sphenoidotomy
SYN	: Synechea
U	: Uncinectomy

S.No	Name	Age	Sex	IP No	Anatomical Variations Score	CT Scan-PNS Score	DNE Score	Surgery done	Visibility Grade	Complications		Management of complications
										MAJOR	MINOR	
1	MUNIVEL	25	M	48878/08	2	10	5	M,AE	I	-	-	-
2	VETRI	22	M	51314/08	0	9	4	M,AE	II	-	-	-
3	GOPI	32	M	52750/08	2	12	6	M,AE,PE	III	-	-	-
4	RAJASEKAR	46	M	56491/08	1	22	10	P,M,AE,PE,S,F	III	-	-	-
5	MALLIGA	50	F	58116/08	0	16	10	P,M,AE,PE	II	-	-	-
6	RAJESH	21	M	61539/08	2	14	6	M,AE,PE,F	II	-	S	RELEASE
7	AMBIKA	40	F	61807/08	0	18	11	P,M,AE,PE,F	III	-	-	-
8	PANDURANGAN	49	M	63690/08	3	11	5	M,AE,PE	II	-	-	-
9	SRINIVASAN	45	M	63696/08	0	12	6	M,AE,PE,F	III	-	-	-
10	BASHA	60	M	65667/08	3	9	4	M,AE	II	-	-	-
11	UMAR	34	M	66222/08	0	14	6	M,AE,PE,S	II	-	-	-
12	RAMAKRISHNAN	38	M	67064/08	2	12	5	M,AE,PE	II	-	-	-
13	EGAVALLI	40	F	67380/08	0	20	10	P,M,AE,PE,F	II	-	-	-
14	PRABHAKARAN	28	M	67577/08	1	11	4	M,AE	I	-	-	-
15	RANI	43	F	67945/08	2	22	12	P,M,AE,PE,S,F	IV	-	-	-
16	VENKATESAN	27	M	68112/08	0	12	5	M,AE,PE	II	-	-	-
17	RAJESH	22	M	68121/08	2	10	5	M,AE,PE	II	-	-	-
18	MANIKANDAN	25	M	68936/08	0	14	6	M,AE,PE,F	II	-	-	-
19	MUNIAMMAL	42	F	69273/08	2	22	12	P,M,AE,PE,S,F	III	-	S	RELEASE
20	MATHEW	30	M	69526/08	1	20	10	P,M,AE,PE	II	-	-	-
21	LAVANYA	19	F	69836/08	0	19	11	P,M,AE,PE,F	III	-	-	-
22	RAJAMANICKAM	45	M	70046/08	0	11	5	M,AE,PE	II	-	-	-
23	DAMODARAN	52	M	71426/08	2	21	12	P,M,AE,PE,S,F	III	-	-	-
24	DINAKARAN	28	M	73286/08	1	10	4	M,AE	II	-	-	-
25	BUVANESHWARI	28	F	73556/08	2	20	11	P,M,AE,PE,S,F	II	-	-	-
26	BASHA BAI	43	M	75090/08	1	12	4	M,AE	II	-	-	-
27	TAMILSELVI	35	F	76678/08	1	14	6	M,AE,PE	III	-	B+	ANP
28	PALANIAPPAN	40	M	78220/08	3	14	6	M,AE,PE	II	-	-	-
29	MANIKANDAN	17	M	78745/08	0	11	6	M,AE,PE	II	-	-	-
30	KUPPAN	37	M	78796/08	1	12	5	M,AE,PE	II	-	-	-
31	SURYAKUMAR	28	M	79675/08	2	10	4	M,AE	II	-	-	-
32	SHAKUNTHALA	45	F	80066/08	0	9	5	M,AE	I	-	-	-

33	VENKATESAN	24	M	81074/08	2	12	5	M,AE,PE	II	-	-	-
34	SENTHILKUMAR	27	M	81867/08	1	20	11	P,M,AE,PE,S,F	III	-	-	-
35	MOTTAIAN	52	M	81909/08	0	19	12	P,M,AE,PE,S,F	III	-	-	-
36	SHEELA	25	F	82100/08	2	18	10	P,M,AE,PE,F	II	-	-	-
37	YOGANATHAN	40	M	82543/08	0	22	12	P,M,AE,PE,S,F	III	-	S	RELEASE
38	KRISHNAMMAL	56	F	84310/08	2	20	11	P,M,AE,PE,S,F	III	-	-	-
39	NARAYANAN	24	M	84725/08	3	12	5	M,AE,PE	II	-	-	-
40	MAHABOOB ALI	29	M	84734/08	1	9	4	M,AE	I	-	-	-
41	VENKATESAN	25	M	86008/08	0	18	10	P,M,AE,PE,F	III	-	-	-
42	PANDIAN	22	M	86686/08	1	10	5	M,AE	II	-	-	-
43	RAGUNATH	30	M	87170/08	3	10	6	M,AE,PE	II	-	-	-
44	RAJI	40	M	88037/08	0	9	5	M,AE	II	-	-	-
45	SURESH BABU	20	M	88479/08	1	14	6	M,AE,PE	III	-	-	-
46	MOHAN	17	M	88502/08	2	12	5	M,AE,PE	II	-	-	-
47	VIJAYAKUMAR	32	M	88511/08	0	10	4	M,AE	I	-	-	-
48	SUBASH	14	M	88849/08	3	11	4	M,AE	I	-	-	-
49	MANIMEGALAI	30	F	89289/08	2	19	10	P,M,AE,PE,F	IV	-	S	RELEASE
50	YUSUF SHERIF	37	M	95338/08	0	11	4	M,AE	II	-	-	-
51	MADURAIMURTHI	42	M	133/09	3	20	11	P,M,AE,PE,S,F	III	CSF LEAK	-	END. CLOSE
52	VENNILA	38	F	1317/09	2	12	7	M,AE,PE,F	II	-	-	-
53	UMADEVI	22	F	1548/09	0	12	5	M,AE,PE	II	-	-	-
54	NAZEEMA BEGAM	49	F	1930/09	2	11	5	M,AE	II	-	-	-
55	TAMILARASI	38	F	2337/09	0	10	5	M,AE	I	-	-	-
56	SELVAKUMAR	24	M	2643/09	0	9	4	M,AE	II	-	-	-
57	MYTHILI	21	F	5087/09	4	14	6	M,AE,PE,S	III	-	-	-
58	LOGANATHAN	18	M	5721/09	0	9	4	M,AE	II	-	-	-
59	GANGADARAN	34	M	7133/09	1	11	5	M,AE	II	-	-	-
60	DANDAPANI	31	M	9198/09	2	20	12	P,M,AE,PE,S,F	III	-	S	RELEASE
61	DINAKARAN	28	M	9258/09	0	12	6	M,AE,PE	II	-	-	-
62	THANGAMANI	35	F	9260/09	2	11	4	M,AE	II	-	-	-
63	RAMU	42	M	11886/09	0	10	5	M,AE	II	-	-	-
64	YUVARAJ	27	M	11917/09	1	10	5	M,AE	II	-	-	-
65	LAKSHMI	32	F	12464/09	0	9	5	M,AE	II	-	-	-
66	GANDIMATHI	50	F	13332/09	3	12	7	M,AE,PE,F	III	-	-	-
67	DEIVAKALA	23	F	13336/09	0	11	7	M,AE,PE,S	II	-	-	-

68	SUBRAMANI	54	M	14618/09	0	22	11	P,M,AE,PE	II	-	-	-
69	SHANTHI	39	F	15051/09	0	18	11	P,M,AE,PE	III	-	-	-
70	MEGARAJ	29	M	15356/09	4	12	7	M,AE,PE,S,F	III	-	-	-
71	DEEPAN	15	M	15892/09	2	11	6	M,AE,PE	II	-	-	-
72	SHANTHI	20	F	17072/09	0	9	4	M,AE	II	-	-	-
73	SUGANTHI	25	F	18253/09	1	11	5	M,AE,PE,S	II	-	S	RELEASE
74	GNANAM	31	M	18475/09	0	12	5	M,AE,PE,F	II	-	-	-
75	ANANTHAN	28	M	19812/09	3	20	12	P,M,AE,PE,S,F	IV	-	P.EMPHY	CONSER
76	SURESH	27	M	21210/09	3	21	10	P,M,AE,PE,F	III	-	S	RELEASE
77	KALIAMMAL	22	F	22890/09	0	18	11	P,M,AE,PE,S	III	-	-	-
78	LATHA	21	F	27357/09	1	17	10	P,M,AE,PE	II	-	-	-
79	JABIN	38	F	27860/09	3	12	7	M,AE,PE,S,F	II	-	P.ECC	CONSER
80	NAZEER	40	M	28183/09	0	21	11	P,M,AE,PE,F	II	-	-	-
81	SARAVANAN	26	M	28289/09	1	11	4	M,AE,PE	II	-	-	-
82	CHINNASAMY	49	M	29516/09	0	12	5	M,AE,PE,F	II	-	-	-
83	SELVAKUMAR	20	M	29518/09	1	10	4	M,AE	II	-	-	-
84	SOUNDARI	30	F	29906/09	3	14	6	M,AE,PE,S,F	III	-	-	-
85	VIMALA	58	F	30866/09	0	9	4	M,AE	I	-	-	-
86	SUSEELA	28	F	31930/09	3	11	5	M,AE,PE	II	-	-	-
87	FATHIMA	30	F	32441/09	1	11	6	M,AE,PE	II	-	-	-
88	KUMAR	32	M	32730/09	0	22	12	P,M,AE,PE,S,F	III	-	S	RELEASE
89	CHITRA	24	F	32733/09	0	9	5	M,AE	II	-	-	-
90	LAKSHMI	28	F	32738/09	1	11	5	M,AE,PE	II	-	-	-
91	MUNIAMMAL	55	F	35715/09	0	10	4	M,AE	II	-	-	-
92	PRAVEEN	25	M	35719/09	4	12	6	M,AE,PE,S	III	-	-	-
93	USHA	24	F	35728/09	2	11	6	M,AE,PE	II	-	-	-
94	KAVITHA	20	F	40903/09	2	10	4	M,AE	II	-	-	-
95	VASANTHA	50	F	42917/09	0	22	11	P,M,AE,PE,S,F	IV	-	B++	PNP
96	ANANTHI	37	F	43496/09	1	11	4	M,AE,PE	II	-	-	-
97	SHANKAR	30	M	43531/09	2	12	6	M,AE,PE,S	II	-	-	-
98	ILAMPUHAZHAL	17	M	46817/09	0	16	12	P,M,AE,PE,S	III	-	-	-
99	LOGANAYAKI	24	F	44340/09	0	10	4	M,AE	II	-	-	-
100	BHUVANA	17	F	45055/09	2	18	11	P,M,AE,PE,F	II	-	-	-

PATIENT CONSENT FORM

Study Detail : A Comprehensive Study on Complications of Endoscopic Sinus Surgery

Study Centre : Upgraded Institute of Otorhinolaryngology,
Madras Medical College & Government General Hospital, Chennai -3
Institute of Child health, Egmore, Chennai 600 008.

Patient Name :

Patient Age :

Identification Number :

Patient may tic (✓) these boxes

I confirm that I have understood the purpose of procedure for the above Study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction. ☐

I understand that my participation in the study is voluntary and that I am free to withdraw at anytime without giving any reason, without my legal rights being affected. ☐

I understand that Investigator, Regulatory authorities and the Ethics committee will not need my permission to look at my health records both in respect to the current study and any further research that may be conducted in relation to it, even if withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study. ☐

I agree to take part in the above study and to comply with the instructions given during the study and faithfully co operative with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well being or any unexpected or unusual symptoms, ☐

I hereby con sent to participate in this study. ☐

I hereby give permission to undergo complete clinical examination and diagnostic tests including hematological, biochemical, radiological tests. ☐

Signature/Thumb Impression: Place Date
Patient Name and Address:

Signature of the Investigator: Place Date
Study Investigator's Name:

INSTITUTIONAL ETHICAL COMMITTEE
MADRAS MEDICAL COLLEGE,CHENNAI-600 003.

Telephone : 25363970

Fax :044 – 253-5115
:044 25363970

L.Dis.No. 14597/M E5/EthicsDean/MMC/2009 Dated .09.2009

Title of the work : "A comprehensive study on complications of endoscopic sinus surgery"
Principal Investigator : Dr. Jude Anselm Sayyas - P.G; M.S (E.N.T)
Department : madras medical college, ch-3

The request for an approval from the Institutional Ethical Committee(IEC) was considered on the IEC meeting held on 23rd September 2009 at 2.00P.M. in Madras Medical College, Deans, Chamber, Chennai-3. /pharmacology seminar hall, madras medical college, ch-3

The members of the Committee, the Secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

The principal investigator and their term are directed to adhere the guidelines given below:

1. You should get detailed informed consent from the patients/participants and maintain confidentiality.
2. You should carry out the work without detrimental to regular activities as well as without extra expenditure to the Institution or Government.
3. You should inform the IEC in case of any change of study procedure, site and investigation or guide.
4. You should not deviate form the area of the work for which I applied for ethical clearnance.
5. You should inform the IEC immediately, in case of any adverse events or serious adverse reactions.
6. You should abide to the rules and regulations of the institution(s).
7. You should complete the work within the specific period and if any extension of time is required, you should apply for permission again and do the work.
8. You should submit the summary of the work to the ethical committee on completion of the work.
9. You should not claim funds from the Institution while doing the work or on completion.
10. You should understand that the members of IEC have the right to monitor the work with prior intimation.

SECRETARY
IEC, MMC,CHENNAI

CHAIRMAN
IEC MMC CHENNAI

21/10/09
DEAN
MADRAS MEDICAL COLLEGE
CHENNAI